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# The Floating Caisson for the Panama Canal Locks

By Lewis A. Mason*

A huge floating caisson or gate for the Panama Canal locks was recently towed from San Francisco to the canal. Its object is to close the entrance to any of the lock chambers when the miter gates are to be painted or repaired, or when the culvert gates are to be inspected.

This caisson, designed by the writer, is believed to be the largest one ever constructed. It cost $335,000 and was over a year in building; the Union Iron Works, San Francisco, constructed it. Towing the caisson to Panama was a considerable undertaking in itself, requiring 43 days. Launching took place on July 25, 1914, and the trip to Panama started Sept. 16.

The clear width of the lock chambers is 110 ft. Beyond the line of the emergency dams the approach is widened by an offset of 3 ft. on either side. The shoulders so formed, with the connecting horizontal sill across the bottom of the chamber, will serve as a seat for the caisson. When the caisson has been floated to place in the recess, water is let into its lower compartments, causing it to sink until properly seated. After this is accomplished, pumps in the caisson unwater the lock chamber, while the water pressure from the outer side of the caisson will force it securely against its seat in the masonry. When it is desired to remove the caisson the lock chamber is filled with water by opening the culverts within the lock walls; this relieves the pressure against the outer side and the water within the caisson is then pumped out to allow it to be floated away.

The caisson is designed for use at all of the 12 lock entrances, and the entrance to the permanent dry dock at Balboa, which also has mitering gates of the same type as the locks. It has a light draft of 32 ft. to allow its convenient handling through the various locks. The top of the sill at the Pacific end of the Miraflores locks is 50 ft. below mean sea level; the tidal fluctuation, which raises the level of the water as high as 11 ft. above mean tide, requires that the caisson be sunk to a draft of 61 ft. when used at high tide. Provision for a proper freeboard makes the aggregate depth of the structure 66 ft. The achievement of statical stability at the various depths of immersion without undue bulkiness or excessive weight in the different drafts makes the caisson of especial interest.

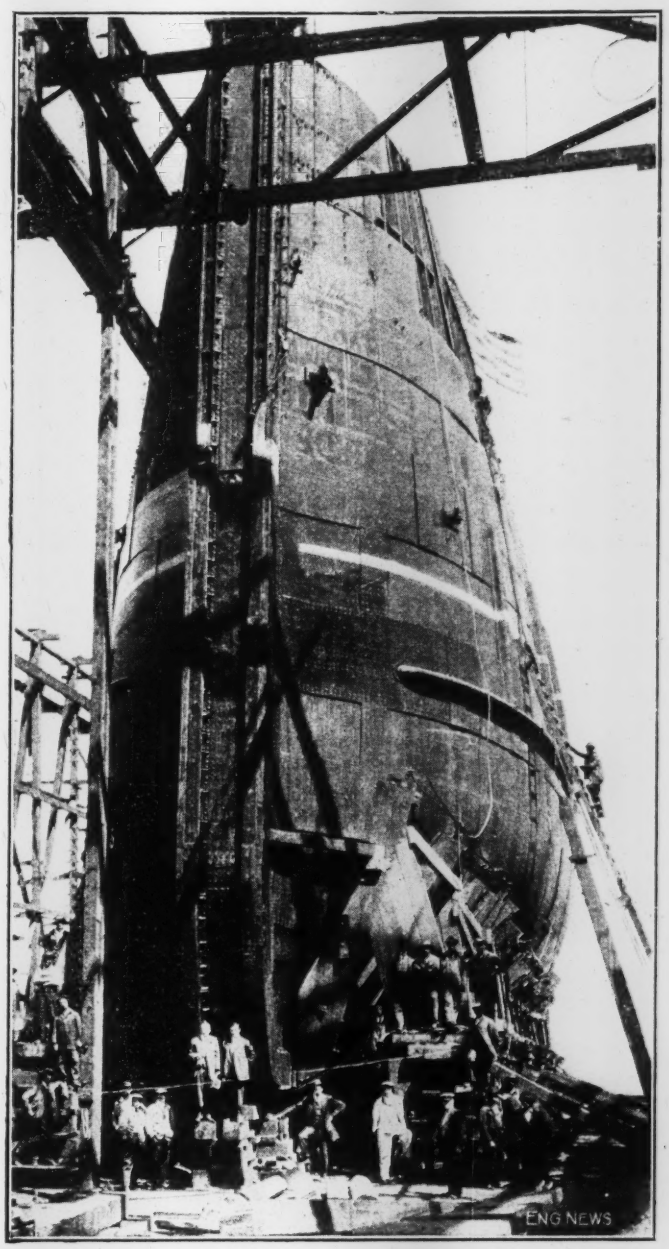


Fig. 1. Bow View of the Gate Caisson for the Panama Canal Locks on Launching Day (July 25, 1914)

(Union Iron Works, San Francisco, Calif., builders.)

In form the caisson has convex bottom, pointed ends, and sides sloped inward from the maximum width of 36 ft. (at about one-third the way up from the keel) to a breadth half as great at the top deck (see cross-section, Fig. 2). The water-line sections resemble those of merchant ships, but are more blunt at the ends on account of the vertical end girders or stems. The length is 112 ft. 6 in. between perpendiculars, and 113 ft. 10 in. over all, including the timber cushions.

## Structural Design

The water pressure against the caisson (when

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acting as gate) is transferred to the gate recess by horizontal decks and breasthooks (short decks between the main decks at the ends). A system of vertical framing built intercostally, extending from the keel to the top deck, transmits the panel loading to the various decks and breasthooks.

The essential features of the structure are the transverse and longitudinal framing, with bulkheads; the horizontal plate decks, girders and stringers; the girders at the vertical ends and along the keel; the end breasthooks, and the sheathing plates to cover the skeleton forming the hull proper. The material of the structure is openhearth structural steel.

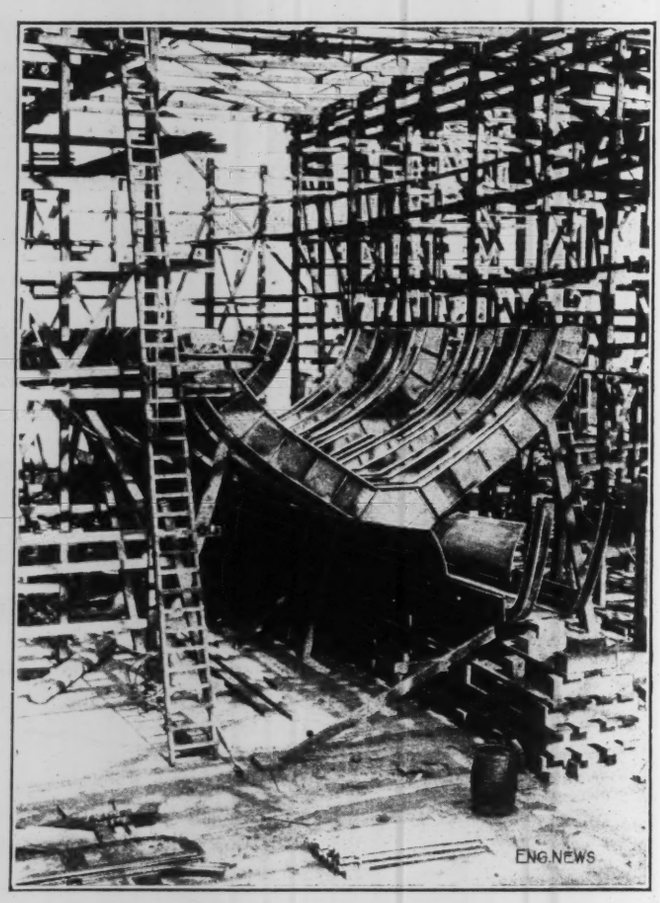


FIG. 2. KEEL AND PART OF LOWER FRAMING IN PLACE
(Feb. 24, 1914.)

Nine cross-frames spaced 12 ft. apart, extend the entire length of the caisson; intermediate frames are spaced 2 ft. apart between the main cross-frames. All are built intercostally between the five horizontal decks. The last cross-frame at each end is made water-tight, to form peak trimming tanks for maintaining a level keel. The seven other cross-frames serve as swash bulkheads for controlling the water within the caisson.

The five horizontal decks are located, respectively, 16 ft., 25 ft., 37 ft., 49 ft., and 65 ft. above the center line of the keel plate. The 16-ft. deck forms the bottom of the trimming tank. The 37-ft. or operating deck is made absolutely water-tight; it has water-tight manholes for gaining access to the various compartments below and water-tight hatches for the removal of the pumps or valves in case it is necessary to make any repairs, etc., to them. This deck is made of sufficient strength to withstand a hydrostatic head of 25 ft. Upon it are placed the various motors for operating the pumps, the switchboard, the water gages, chain lockers, etc. The 49-ft. deck is of open-truss construction, having diagonal bracing for the central two-thirds of its length and plating covering the ends. Six breasthooks or short decks between the main decks transmit part of the loading to the vertical end girders. In addition there are two lines of longitudinal intercostals located equidistant between the keel and the 16-ft. horizontal deck, securely riveted to the transverse frames and to the sheathing.

Steel castings at the ends of the decks and breasthooks transmit the water loads to the vertical end girders.

The sheathing is composed of longitudinal plating, worked in in-and-out strakes, making lap seams and butt joints which have double splice plates. Around all of the openings in the plate decks and in the sheathing, doubling or reinforcing plates are fitted. To protect the sheathing when maneuvering the caisson near the lock walls, fenders are provided on the exterior of the sheathing along the 25-ft. and 49-ft. levels and vertical fenders are placed between the horizontal ones at seven of the amidship cross-frames. The fenders are built of bent plates, se-

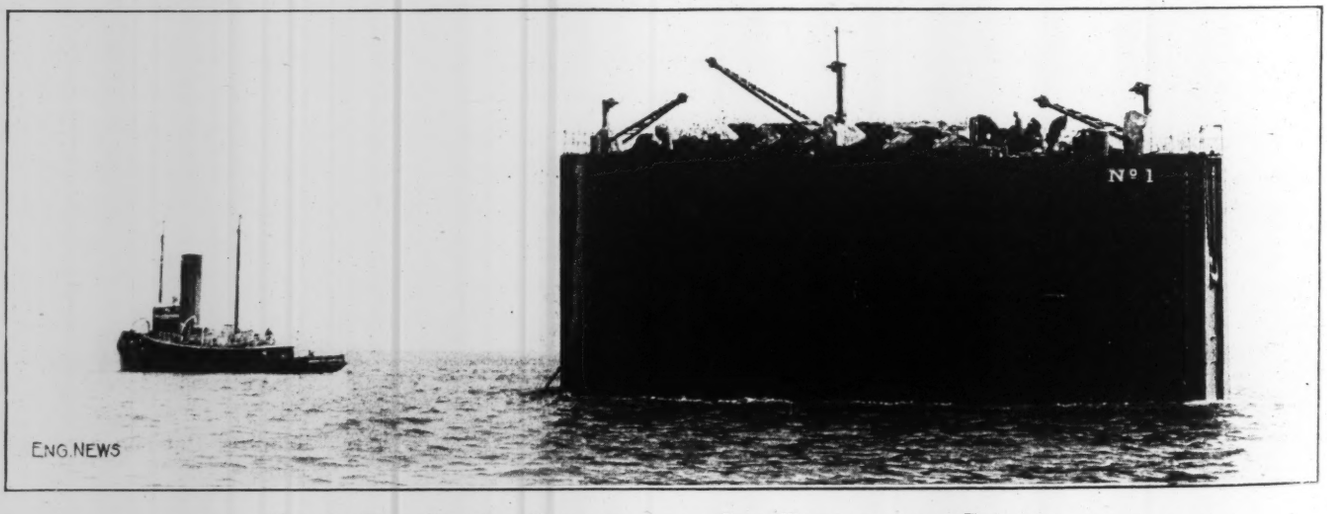


FIG. 3. THE CAISSON STARTING FROM SAN FRANCISCO FOR PANAMA

(The caisson left San Francisco Sept. 16 and reached Balboa Oct. 29. The voyage was so rough that the crew aboard deserted at the first port of call, declaring they would not risk their lives further. The journey was completed without anyone aboard the caisson. It required 43 days for the trip from San Francisco to the Canal.)

rely riveted and calked to the sheathing plates; the ace between is filled with "Petrolastic" cement (a by-duct of crude oil; specific gravity 1.02, expansion at mperature of 110° 0.0018, melting point 150° to 200° ).

Because of the long towing distance from its place of ilding, two large towing rings are fastened to the eathing and to the 13-ft. breasthook at both ends and on each side of the caisson. As a means for towing the isson from its mooring position to any one of the lock each end of the caisson on the top deck. The capstans are for the purpose of warping the caisson into its seat and each is capable of withstanding a pull of 10,000 lb.

To increase the draft of the caisson to a sufficient depth to insure its stability at light draft, and without any water in the ballast compartments, approximately 800 tons of permanent ballast, composed of iron punchings, concrete, etc., is placed in the bottom.

An anchor chain, made of material $1\frac{2}{16}$ in. in diameter, is provided at each end for mooring the caisson when not

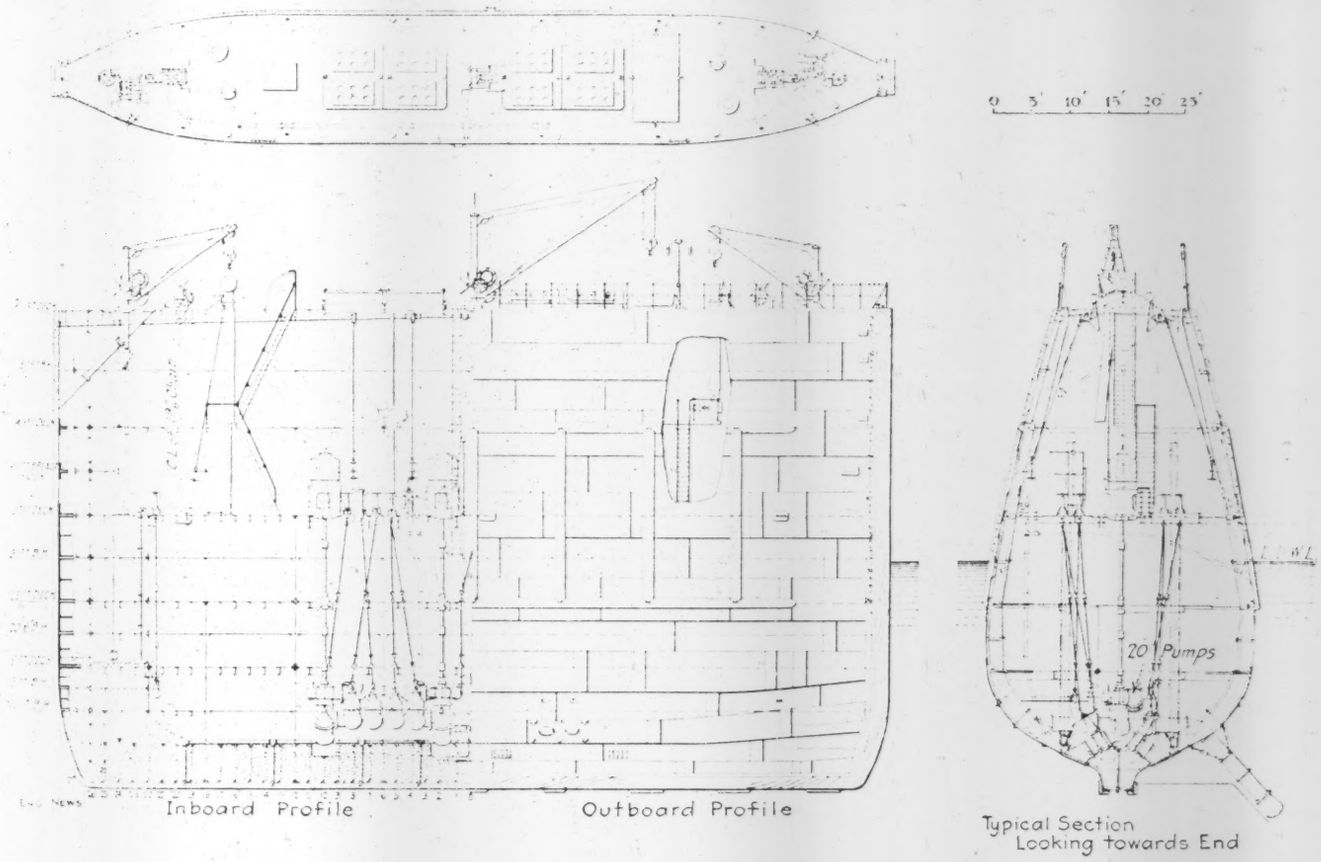


FIG. 4. GENERAL SECTIONS, PANAMA CANAL GATE CAISSON

sites, three towing rings are riveted at the level of the 37-ft. horizontal deck on both sides of the caisson.

Along the exterior of the keel and the vertical ends, channel-shaped steel castings are securely riveted to the keel, vertical ends and sheathing. Into these, cushions of British Guiana greenheart and Australian ironbark timber are fitted and bolted. Similar cushions are fitted along the sides of the keel and along the sides of the vertical ends, to serve as a seal against the gate recess.

## EQUIPMENT

There are three portable cranes located on the top deck, one at each end of the caisson and one in the center. The two end cranes, capable of raising 3000 lb. at a radius of 14 ft., by two-man power, are to be used for lifting various loads from the lock walls, as well as for handling the electric-power cables. The middle crane is a little heavier in construction than the end cranes, being capable of raising or lowering a load of 3000 lb. at a radius of 25 ft. by two-man power. This crane will handle the pontoon, stowed on the top deck, when it is desired to make the suction-pump-extension attachments and is capable of lifting the top sections of either of the two skylights. A hand-operated deck capstan is provided and placed at

in service, to floating buoys in the lakes. The anchor chains are raised or lowered by means of hand-operated winches located at each end of the top deck.

## PUMPING SYSTEM

Unwatering the lock chambers (excepting the ones which may be emptied by gravity) will be done by pumps in the caisson. The only lock chambers in the canal that can be emptied by gravity are the upper lock chambers at Gatun, whose floor is $132\frac{5}{8}$ ft. above sea level.

The main pumping system consists of four vertical-shaft centrifugal pumps having a 20-in. discharge and a 22-in. suction. The capacity of the pumping system is designed so that it shall pump out in not over 25 hours' time all of the water in the upper and lower chambers of one flight of the Miraflores locks between mean sea level (El. 0) and the top of the sill of the lower chamber (El. —50), the tidal level to be at El. 0 when pumping is begun and the tide rising. The total quantity to be pumped is estimated at 10,285,000 cu.ft., including 518,000 cu.ft. for leakage through the valves in the lock culverts and around the sills of the mitering lock gates and the caisson sill. The pumps will take out, when operating at any stage of the tide, the water from the

floors of the lower lock, from the top of the sill (El. —50) to 2 ft. below the sill, through a 22-in. suction pipe attached to the auxiliary suction inlets in the caisson, and extending into the nearest lateral culvert in the lock chamber.

Two of the pumps have the piping systems arranged for pumping out the caisson when it is to be removed from its position against the sill.

When not in service, the four suction extension pipes are stowed in cradles on the 49-ft. deck. They are handled by the large deck crane located at the middle of the top deck.

An electric horizontal centrifugal pump with 3½-in. suction and 3-in. discharge is located on the operating deck. It has suitable pipe connections leading from the suction to a manifold, and from the discharge to another manifold. From these manifolds piping is connected to the end peak trimming tanks, to the deck scuppers, to the sea and to a mud-slushing device. The mud-slushing device is intended to remove mud from the sill in an endeavor to prevent any adhesion to its seat when the caisson is in the act of raising.

The main pumps are driven by 200-hp. vertical three-phase induction motors wound for 25 cycles, 220 volts, and a speed of 750 r.p.m. The motors for operating the ventilating fan and the 3-in. auxiliary pump are induction motors of the horizontal type and with the same wiring as above. For lighting purposes 110-volt current is used. All of the electric motors with the exception of the one driving the multivane exhauster, and the switchboards for the same, are located on the operating deck, 37 ft. above the base line. All of the valves in the pumping system are operated from the same deck.

## A New Hydraulic Stop Valve

By C. W. Larner*

The new type of hydraulic stop valve, invented by R. D. Johnson, Hydraulic Engineer of the Ontario Power Co., of Niagara Falls, N. Y., and being developed (by the Wellman-Seaver-Morgan Co.), for water-supply and

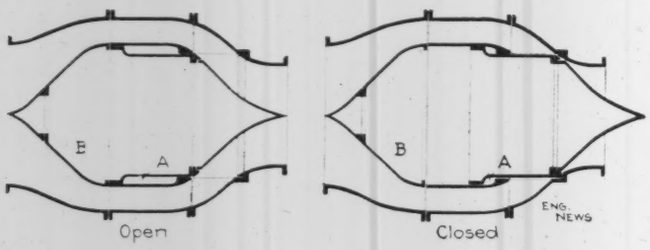


Fig. 1. Section through a Johnson Hydraulic Valve

water-power work is attracting widespread interest. Therefore, the following notes on design and construction are offered.

Fig. 1 shows the general arrangement of a horizontal valve of this type. It consists essentially of a circular body forming an enlargement of the pipe-line or penstock, and having an internal cylindrical chamber containing a sliding plunger. The closed end of the internal chamber and the nose of the plunger are designed to guide the water smoothly as it enters and leaves the

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Fig. 2. A 9-Ft. Vertical Johnson Valve Built for the Ontario Power Co.

valve. The waterways throughout the valve offer no obstruction to the flow, and the loss of head is practically nothing.

When the plunger is withdrawn into the internal or operating chamber (at the left, in Fig. 1), the valve is open and presents a clear passage for the water. When the plunger is extended from the operating chamber, it seats against a ground ring in the neck of the valve body, stopping the flow. The standard control mechanism provides for only the open and closed positions of the plunger, but it may be specially arranged to hold the plunger at intermediate positions if desired.

The valve plunger is of the differential type, forming an annular chamber *A* within the operating chamber *B*. The valve is equipped with suitable piping and a control valve which admits pipe-line pressure to *A* and exhausts it from *B* to open the valve; and admits it to *B* and exhausts it from *A* to close the valve. The valve may be operated equally well in still or flowing water, and the direction of flow through the valve is immaterial. In contrast with the gate or butterfly types, it may be closed without imposing unusual stress on any part of the valve. In case of a break in the pipe-line beyond the valve, there is no difficulty in closing the latter in the usual manner and at the usual rate. There is no possibility of water-hammer.

The control valve for small valves is of the plug type and that for large valves is of the balanced-piston type. Both may be operated by hand or by electricity. All of the valves so far built have been equipped with both methods of operation. The control valve and its operating mechanism may be located at a considerable distance from the Johnson valve, if desirable. Thus, the latter may be placed outside of a power house and the control mechanism placed within—an arrangement which may effect a large saving in the cost of a plant.

The neck of the valve body, where the plunger seats,

is made smaller than the other end which connects directly to the penstock or pipe-line. A taper section of pipe is installed between the small end of the valve and the pipe line at that end. This arrangement makes a Venturi meter out of the valve, which may be utilized for the measurement of water. Two 12-ft. valves now under construction for the Utah Power & Light Co. will have recording instruments attached to give a daily chart of the quantity of water supplied to the turbines.

Use of the Johnson design is not limited to stop valves. It may be installed for the regulation of impulse wheels in place of the usual type of needle nozzle. Then the oil or water from the governor system acts directly on the valve plunger. This is much simpler and more direct than the customary arrangement in which the plunger is mechanically operated by a regulating cylinder under governor control. Another application of this valve is for automatic pressure relief. The valve plunger is held closed by air pressure so arranged that it is automatically released and discharged when the pipe-line pressure exceeds normal by some predetermined amount. The advantage of using air pressure lies in the rapidity with which the air may be discharged, and the consequent rapid opening of the relief valve.

It is possible to arrange these valves to close automatically in case of a break in the pipe line on either side of the valve, provided the break is sufficiently bad to reduce materially the pressure at one end of the valve. This feature is of inestimable advantage for water-works service. Great damage to property has resulted in many cases from broken mains, because of the inevitable time which must elapse before the valves can be closed by hand, and the great difficulty experienced in closing gate valves under such conditions.

## Periodical Levee Slip at Helena, Ark.

In our issue of Nov. 20, 1913, was given an account of the sloughing off of 1,500,000 cu.yd. of earth from one of the largest levees in the Mississippi Valley, and also some account of the history of that particular levee, which showed that sloughing off during periods of extreme low water was a regular occurrence.

Consequently it was presumed that readers would be interested in the method of reconstruction, and accordingly, in our issue of Mar. 19, 1914, a description of the rebuilding of the levee by dumping from a 20-ft. trestle was given, together with a statement by the engineer in charge defending this method, which he contended resulted in better compacting the earth than when the fill was made by teams in 3-ft. layers, in the regular way.

Be that as it may, our readers will be interested to know that during the dry season of August and September of this year, a new slip occurred in this new levee, which near the place shown in the accompanying illustrations was about 300 ft. in the rear of the old levee. This latest slip occurred at the junction of the old and new levees, or above the breaks of previous years. The estimated loss by the new slip is $20,000. It has not been possible to obtain any information about this latest slip from the engineer in charge.

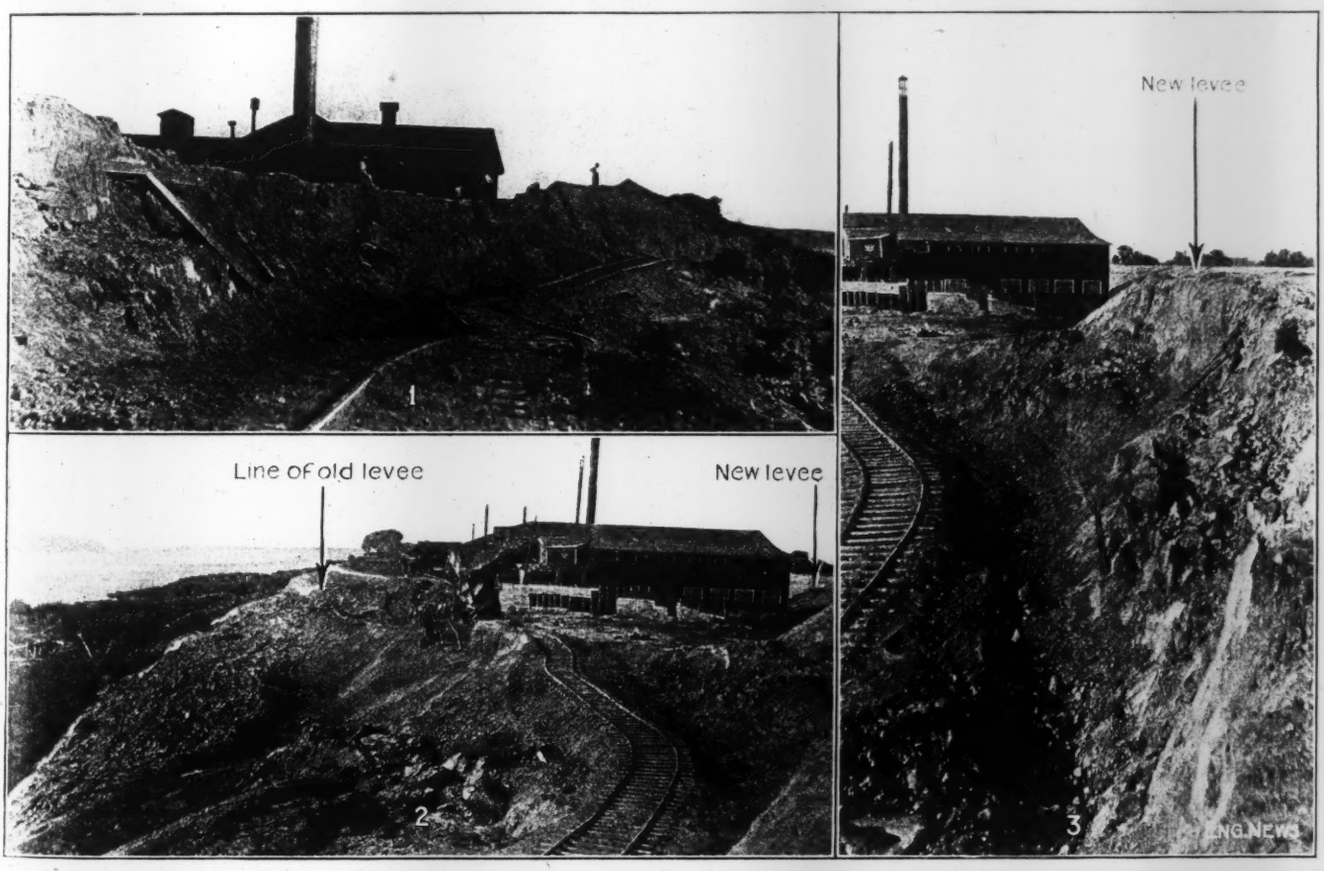


Fig. 1. Sloughing Off of New Levee at Helena, Ark.: Looking North

Fig. 3. Looking South over the New $20,000 Levee Slip

Fig. 2. Looking South from the Junction of the New and Old Levees

# New York Rapid Transit Railway Extensions*

By F. Lavis†

## VIII.—Excavation

The general specifications provide for the classification of excavation as earth and rock, rock being ledge rock in place and boulders over ½ yd. Earth excavation is classified as above or below mean high water, and the prices "include the cost of the disposal of the materials excavated, of backfilling, of all decking and bridging for support of street travel, of all sheeting and bracing,

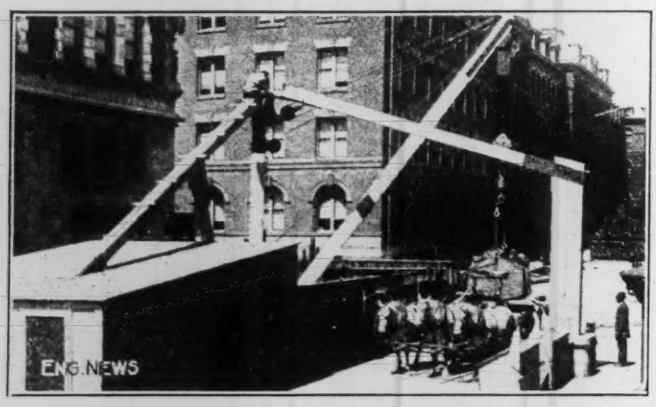


FIG. 43. DERRICK FOR HOISTING SKIPS AT 77TH ST. AND LEXINGTON AVE.

and of maintenance and supporting of trenches during and after excavation, of all pumping or bailing, and of the maintenance and support, with all incidental work, labor and material of any kind, of all surface, subsurface and overhead structures and surfaces." (Support of street-railway tracks and elevated railroads is paid for separately as noted below. Underpinning of buildings when required is also paid for separately.)

Rock excavation is paid for, for 6 in. outside the neat line at the sides but no allowance is made on the bottom. It is required that all excavation in rock beyond the side neat lines of the structures shall be refilled solid with concrete which, except for the first 6 in., is at the expense of the contractor, so there is every incentive to avoid excessive excavation and for the use of care in drilling and blasting at the sides.

When pipes, sewers, electric-wire conduits, etc., have to be removed and rebuilt elsewhere, the work is paid for separately. All structures of this kind, however, which do not require change have to be supported and maintained by the contractor, the cost being included in the price paid for excavation. All gas pipes are removed and placed above ground during construction, and replaced afterwards, the necessary house connections, of course, having to be changed each time. This work is paid for at a price bid per lineal foot for each size of pipe which has to be taken care of. The ordinary 4- and 6-in. pipes from which the house supplies are taken are usually relaid along the edge of the sidewalk, on top of the timber decking. The large 10- and 12-in. mains are usually supported overhead.

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In planning the excavation it has generally been found advisable to so arrange the work that if the material is suitable, there will be sufficient left till the end to complete or nearly complete the backfill, which the specifications require shall be made with "sand, gravel or other good, clean earth, free from perishable material, or stones exceeding 6 in. in diameter, and not containing in any place a proportion of stone of or below that size exceeding one part of stone to five parts of earth."

Usually there is no opportunity to store material for this purpose, but on some sections, where there is earth, a certain portion at the ends of the section is left to be excavated after most of the structure is completed. Where this is not possible, or where there is little or no earth, dependence is usually placed on material excavated elsewhere, mostly from cellars, etc., of which there is usually sufficient available at all times and in nearly all sections of New York. In one case the contractor was able to get a vacant lot for disposal of his earth excavation, con-

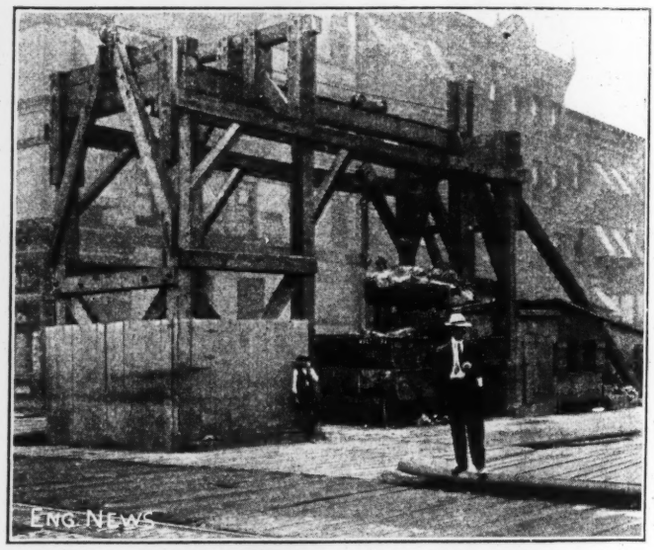


FIG. 44. GANTRY HOIST FOR SKIPS AT 121ST ST. AND LEXINGTON AVE.

veniently located so that it will be practical to remove the material (by steam shovel and train) when required and use it for backfill.

The following table will give a general idea of the range of prices bid for excavation under the many varying conditions.

COST PER CUBIC YARD OF EXCAVATION

| | Earth | | | Sewers | |
|---|---|---|---|---|---|
| | Above m.h.w. | Below m.h.w. | Rock | Earth | Rock |
| In the lower part of Manhattan below 10th St... | $4.50 to 6.00 | $7.00 to 9.00 | $7.00 to 10.00 | $4.00 to 5.00 | $6.00 |
| From 10th to 42d St..... | 4.00 to 5.00 | .... .... | 5.00 to 6.00 | 4.00 to 5.00 | 6.00 |
| 42d to 125th St..... | 3.50 to 5.00 | 6.00 to 8.00 | 5.00 to 8.00 | 4.60 to 6.00 | 6.00 to 8.00 |
| Bronx ..... | 2.25 to 3.00 | 3.00 to 4.00 | 3.00 to 4.00 | 2.00 to 3.00 | 4.00 to 5.00 |

The cost of supporting the tracks of the street or elevated railways is not included in the excavation price, but is paid for separately. The prices bid on the contracts thus far awarded range approximately as follows:

For the support of elevated-railway columns, from $300 to $500 each, though in one case where there were only two, the bid price was $1000 each.

For the support of main electric-railway tracks with underground trolley conduits from $5 to $20 per lin. ft. of single track. A fair average seems to be about $10.

For horse-railway tracks about $5 per lin.ft.

The excavation price does not include the relaying of the sidewalks or curb or repaving the streets, within the neat lines of the excavation; this is paid for at prices bid per square yard, for the various types of pavement. All street surfaces are first repaved with Belgian blocks and maintained by the contractor for six months, after which the final form of new pavement is laid.

Where auto-trucks are used for disposal of excavation, a storage hopper is usually provided at the head of the shaft, which will hold at least one load (or more, depending on the number of trucks in use, and the kind of material), so that there is no more delay in loading than that necessary to open the mouth of the hopper and fill the truck. The general practice seems to be to use hoppers and chutes when the excavated material is earth or a mixture of earth and boulders and to use some form of skip or bucket for rock.

On the Broadway line below 23rd St. the excavation is nearly all in earth. A small amount of rock is found in places but not enough to influence the methods. On account of the timbering and the necessary supports of the street decking, it has apparently been found most convenient and practical to handle all the material by hand. It is shoveled into buckets of about 1 yard capacity, hauled to shafts, hoisted and dumped into

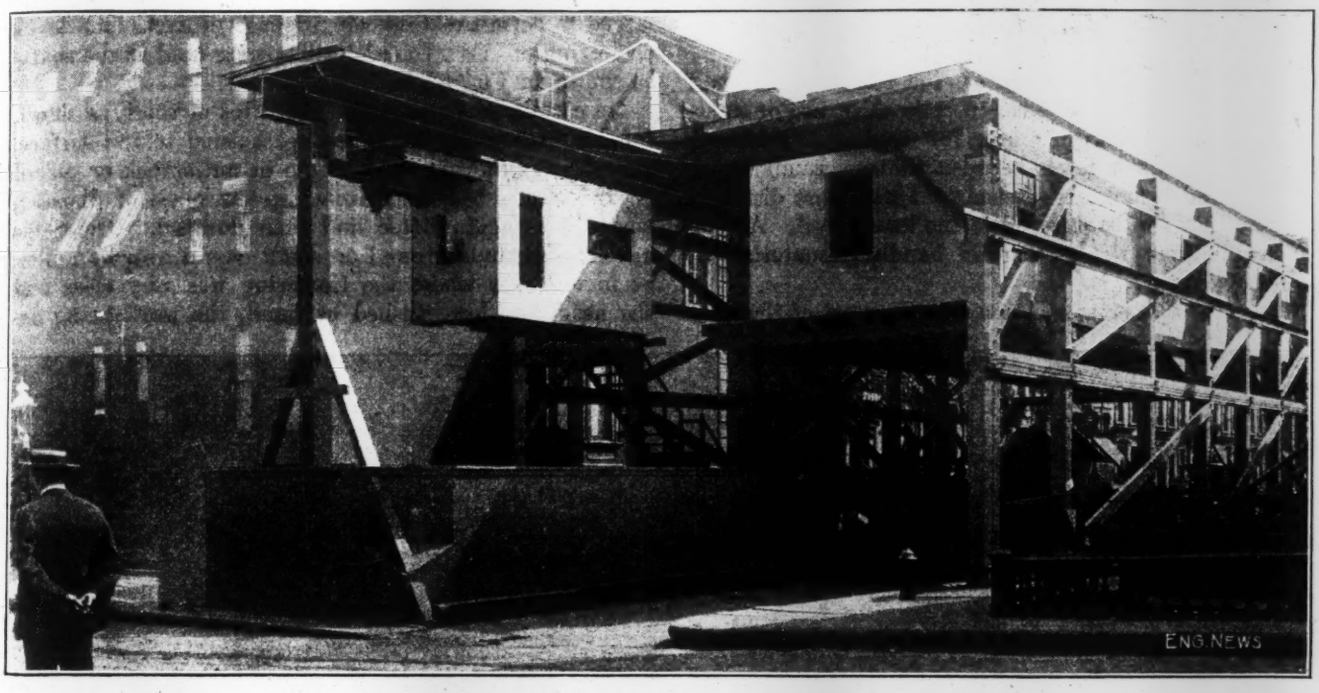


FIG. 45. TELPHER HOIST AT 74TH ST. AND LEXINGTON AVE.

The eight-hour labor law is strictly applied to all this work, no blasting is allowed between 11 p.m. and 7 a.m. and of course, all charges of explosives have to be quite light on account of danger to the timbering or adjacent buildings. On most of the work two shifts are employed, the men generally working from 6 a.m. to 2:30 p.m. and from 3 p.m. to 11:30 p.m. with half an hour for a meal.

All, or nearly all the material taken from the excavation in Manhattan has to be disposed of, usually by haulage to the water front, where it is loaded on scows and towed to the point of disposal. This involves the renting of pier or dock facilities by contractors, and a haul varying from ½ to 1 or 2 miles in wagons or auto-trucks. These latter, holding from 3 to 4 cu.yd., are being quite commonly used, and are generally said to be more satisfactory and cheaper than horse-drawn wagons. It is necessary that they be fully utilized—that is, that there be the least possible delay at loading and unloading points; otherwise the overhead charges, chauffeur's wages, and interest on investment, amount to too large a proportion of the unit cost.

storage hoppers holding 25 to 50 yards, from whence it is discharged into wagons. Haulage to the water front is done almost wholly by teams, but auto-trucks are used on Section 1.

A very efficient and convenient arrangement of hoist and storage hoppers, Fig. 46, was installed at Broadway and Waverly Pl., on Section 4, by the Dock Contractor Co. A vacant lot permitted the construction of a long narrow head-house parallel to the street and over the sidewalk. A telpher was arranged over the shaft and hoppers, which allowed a much more rapid, because better controlled, handling of the buckets than is possible with a derrick boom. A structure of this type would not have been permitted in front of an occupied building.

On one section on Broadway, where the excavation was mostly sand, a belt conveyor was used in the bottom which dumped the material into a hopper, from whence it was elevated to the bin above the street by an endless chain of buckets.

On these downtown sections, fewer shafts are permitted and they are usually from 1200 to 1500 ft. apart, making

FIG. 46. HEADHOUSE OVER SHAFT AT WAVERLY PL. AND BROADWAY

the necessary maximum haul on the bottom about half that. Track of 24-in. gage is generally used, two or sometimes three lines, with mules for haulage. In many places on the upper levels between timbers, small ¾-yd. cars are used, which are pushed by hand short distances to where they can be dumped to the lower level. A typical bridge over the street for handling materials is shown in Fig. 47.

Where the line crosses Union Square, most of the work was done in open cut, an electrically operated shovel being used. Shovels and trains were used on the open-cut work of the Sea Beach line in Brooklyn, and part of the Varrick St. line is in open cut.

The rock excavated from the subways is of little general use for structural purposes. A certain amount of the best of it is permitted to be used in any walls or masses of concrete over 30 in. in thickness, and some of it is used for rubble for blocking up the yokes of the street railway tracks in Manhattan.

### BUCKETS AND SKIPS

On many parts of the work, ¾- to 1-yd. buckets as shown at *A* and *B*, Fig. 48, are used. These are handled in the excavation on small flat-cars on 24-in. gage track, hauled by mules to the shafts, hoisted by derricks to the surface and dumped into the trucks or hoppers. At the face of the cut the buckets are loaded by hand, the simplest form of block and tackle being used to haul out and lift the boulders or pieces of rock too large to be conveniently handled by one or two men.

In one case where turntables were tried opposite the shaft, the tracks being arranged as shown at *A*, Fig. 49, it was found that they frequently got out of order and caused considerable delay so they were taken out and the tracks arranged as shown at *B*, the shaft being enlarged to permit of this being done. On Sections 8 to 11 on Lexington Ave., transfer tables were used at the shafts as shown in Fig. 52.

On certain sections 3- to 4-yd. skips of the type shown in Fig. 44C are used. They are hoisted to the surface, and either dumped into a wagon or auto-truck or placed on the wagon bed, and hauled to the place of disposal, where it is again lifted and then dumped. The skips are handled underground on small cars drawn by mules, or in one case where the timbering was very close and the headroom low, pushed by hand, the work being ar-

FIG. 47. BRIDGE AND DERRICKS AT GRAND ST. AND BROADWAY

ranged so that there was a down grade to the shaft.

The advantage of these large skips over the smaller buckets is greater facility in loading. They are taken off the cars and placed on the ground at the working face, a hoisting engine with a fall suspended from the timbering of the street decking being used for the purpose. There is no lift for the shovelers and, of

course, very much larger pieces of rock can be handled without block-holing and handled more easily.

On Sections 8, 9, 10 and 11, on Lexington Ave., a type of bucket known on the work as a "battleship" (Fig. 43) is used. These buckets hold from 1½ to

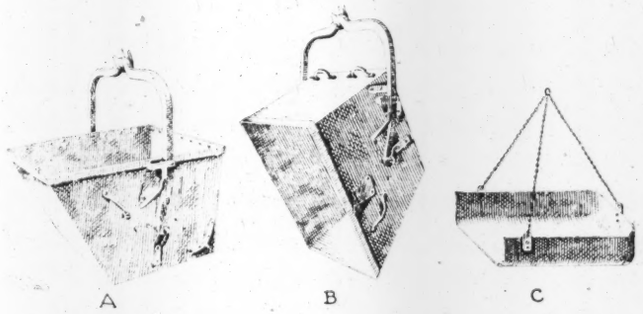


FIG. 48. DUMP BUCKETS FOR HANDLING MATERIAL

2 yards; they are handled in the excavation and tunnels of these sections on small cars (3-ft. gage) with cradles shaped to fit. The cars coast down grade either to or from the working face as the case may be, and are hauled up grade by small stationary hoisting engines. The line from the hoisting engine is usually carried out

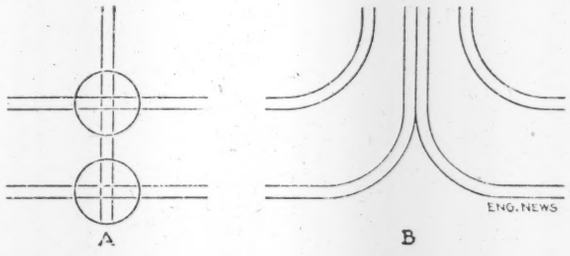


FIG. 49. SKETCH OF TRACK ARRANGEMENTS AT SHAFT

by hand and this method of haulage does not seem very efficient.

The buckets are hoisted to the surface by derricks, Fig. 13, or telpher, Fig. 15, placed on wagon beds and hauled to the dock by horses. This type of bucket with the top some 3½ or 4 ft. above the ground (as they remain on the cars while being loaded) involves a fairly high lift for the shovelers, and the necessity of keeping the tracks up close to the face does not permit the flexibility which is possible with the skips, which are taken off the cars and placed in the most convenient position for loading. Many of these small tunnel cars consist merely of a rectangular frame of 6-in. I-beams to which the axle boxes for two axles are fastened. Those for use with the "battleships" have two or three wooden cross-pieces or cradles cut to fit.

The contracts for Sections 8, 10 and 11, Lexington Ave., are being executed by the Bradley Contracting Co., that for Section 9 by Patrick McGovern & Co. Nearly the whole length of the lower level tracks is in tunnel, the excavation of which is described separately, but the upper-level double track has generally been built as cut and cover. An arrangement has been made whereby the Bradley Company takes care of the disposal of all the material, that from the upper section being hauled to the dock at 96th St. and the East River, and from the lower sections to 76th and 68th Sts.

The use of these skips or the "battleships" is probably of greater advantage in rock excavation than in earth, as some kind of mechanical apparatus for handling the rock is generally necessary at the face and is therefore available to handle the skips on and off the cars and to load large pieces of rock. Small power shovels, operated by electricity or air, are often used for loading the spoil on underground work, but on most of the subway work, the extensive and close system of timbering hardly admits of their use.

The system used for the rock excavation on Section 13 (McMullen, Snare & Triest) seems to be quite effective. Here the rock face is 25 to 35 ft. high, and 40 to 50 ft. wide. After the street decking was put in, a top lift, from 12 to 15 ft. high and mostly earth was taken off the whole length of the section, this permitting working access to the whole job, for underpinning, support of pipes, conduits, etc. A shaft was sunk to subgrade at every other cross street, about every 450 ft., and outside the main excavation. The location of the shafts in the cross streets is shown clearly in the photographs, Figs. 44 and 45. From this shaft a cut was drifted across the full width of the work and the excavation carried forward in both directions from it. About 120 skips were used on this section, and about 400 yd. of rock (place meas-

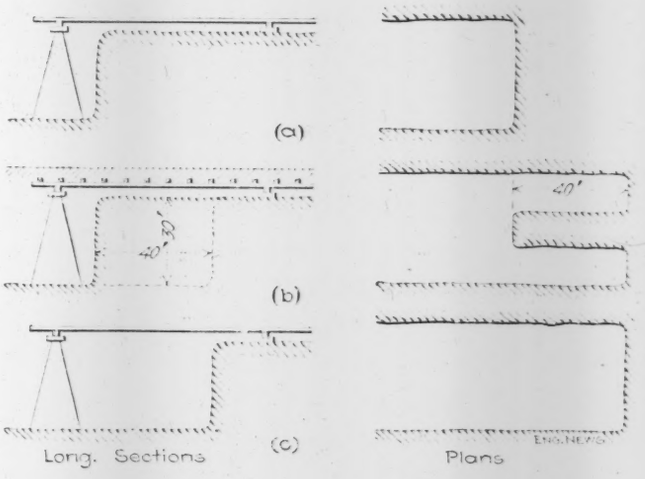


FIG. 50. SKETCH ILLUSTRATING PROGRESS OF EXCAVATION IN DEEP ROCK TUNNEL ON SECTION 13, LEXINGTON AVE.

urement) was handled each 24 hours from the two working faces with the two gantries.

The tower form of timbering (as described under timbering) was used, the working space being spanned by continuous I-beams reaching from the last towers to blocking on the floor of the first lift, as shown in the sketch, Fig. 50. Two side cuts, each about one-third the width of the excavation, were driven ahead 35 to 40 ft., then the center was blasted sideways into these cuts. This, as will be seen, protected the timbering, at least to a considerable extent, from direct blasting against it. When the face at the center was advanced 40 ft., another tower was erected, the girders moved ahead, the process repeated, etc.

Two double-drum air hoisting engines were located back from the face on top, with single fall lines leading over sheaves suspended from the timbers of the street decking above the working space. These two lines (two on each side) handled the larger pieces of rock and the skips on and off the cars, and were also used in handling timbers, etc.

### Derricks and Gantries

On Section 13, Lexington Ave. (McMullen, Snare & Triest), gantries, as shown in Fig. 44, have been installed at the shafts, instead of derricks for hoisting material out of the excavation, and for lowering the structural material. The advantages of these gantries are said to be, greater safety to the public in the streets, greater rigidity, and therefore more security; better speed in hoisting, easier spotting of the skips over the wagon bed, less power required for hoisting, and the elimination of booming up and down with loads. It is said that the saving of power (in regard to which no definite data are available) is due largely to the elimination of the swinging engines which are necessary with derricks. It is also stated that there is a considerable saving in the wire hoisting ropes, which lasted only two to four weeks on the derricks, but which last from three to four times as long on the gantries.

These gantries will also handle heavy loads with much greater security: those now in use have handled loads up to 25 tons. This is of considerable advantage in the rock excavation, as it permits the handling of large rocks without breaking them up. They are so arranged that from 20 to 25 loaded skips can be stored at them (see Fig. 44), thus permitting night work when the teams are not available to haul this material and also permitting considerable flexibility. This latter is a great advantage, owing to the difficulties of disposal, which is dependent on the availability of the scows, a somewhat uncertain item in some of the severe winter weather, the difficulties of haulage in bad weather, and many other factors, as already noted. The teams which haul the spoil to the dock work only eight hours, and by storing the material under the gantries, delays are avoided and the work is accomplished in this length of time. On this work, the big stone is generally loaded into the skips during the day and the finer material, which must be shoveled, is handled by the night shift.

The first of these gantries was made about 40 ft. long and 22 ft. high, but those built afterwards were made 60 ft. long and 27 ft. high, thus giving more storage room, and the extra height greater facility in handling some of the structural steel. There are altogether seven of these in use on Section 13 and one shaft with a derrick. Their use on Section 13 has been apparently very successful, but it is to be noted that they are peculiarly well adapted to the conditions there, and it cannot be assumed that they would replace derricks to so great advantage under other conditions.

### Miscellaneous Excavation Methods

On the first section north of the Harlem River (Section 15, Route 5—Rodgers and Hagerty, contractors), where more latitude was allowed in the matter of opening up the streets, only part of the excavation being decked over, the excavated material was handled in 4-yd. Western dump cars hauled by dinkeys (3-ft. gage) to the disposal grounds ½ to ¾ mile distant.

On the next section to the north at the junction of the Southern Boulevard and 138th St., a model 49 Marion shovel is just being installed for loading the cars and a model 60 Marion was used in the deep rock cut through

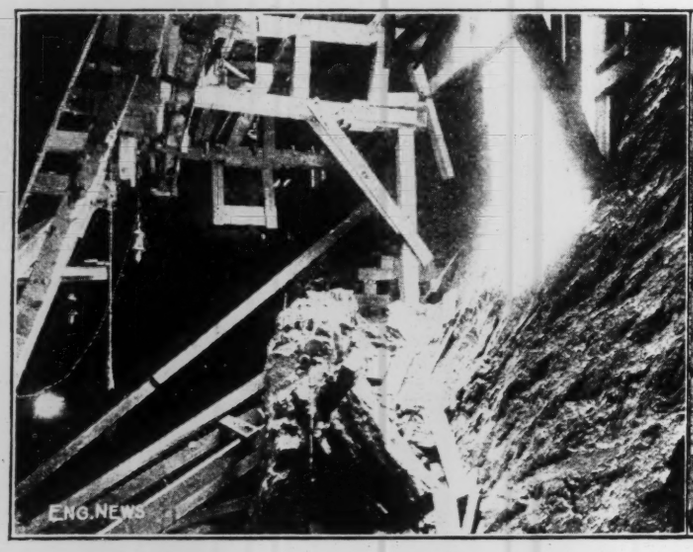


Fig. 51. A Rock Slide, Lexington Ave. Subway

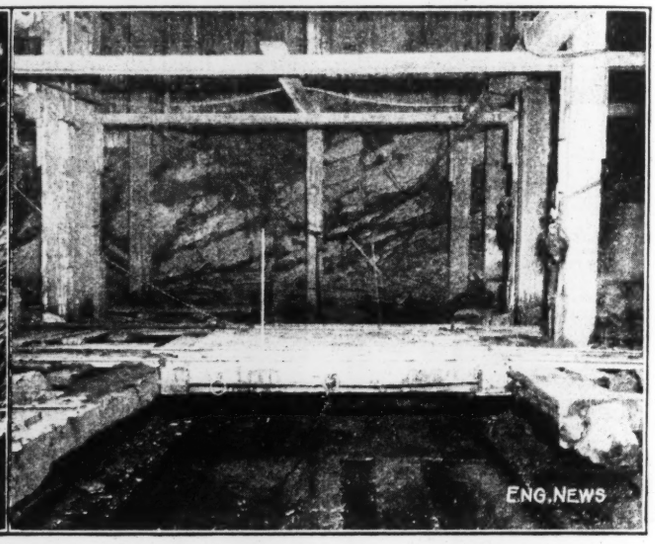


Fig. 52. A Transfer Platform, Lexington Ave. Subway

Franz Sigel Park, on the northwest end of Section 15.

On the steep hill on Lexington Ave. between 102nd and 103rd St. where the traffic is light (on account of the steepness of the hill) and where the tunnel with all four tracks at the same level changes to a cut-and-cover section, one side of the street was left open and a cableway was installed for handling the material.

Varick St. is being widened from its original width of about 60 ft. to 100 ft. and the excavation in this widened portion is being made in open cut, the original width of the street being decked over and the material under it taken out at the open sides. The first lift of 10 to 12 ft. is loaded directly into wagons by shoveling, inclines being built from the surface down to this depth. Much of the excavation is sand, and below the first lift this is loaded into 1-yd. V-shaped Koppel cars which are dumped sideways into a hopper, under which runs a short belt conveyor, which in turn carries the material to a bucket elevator which raises it into a storage hopper above the street level.

Steam shovels were quite generally used on the construction of the 4th Ave., Brooklyn, lines in 1909-10 and

being used now on the open-cut work of the Sea Beach line, but generally speaking, very little use is made of mechanical apparatus of any kind on the subway excavation, most of the excavated material being shoveled by hand.

### Drilling

On Section 13 the drillers work in two 8-hr. shifts, from 6 a.m. to 11 p.m., and the muckers in two shifts, from 8 p.m. to 1 a.m. One feature of considerable interest, is the quite extensive use of the so called Jap or hand hammer drill with hollow drill steel. The New York rock, a soft to medium hard gneiss or mica schist, seems to lend itself particularly well to the operation of this kind of drill in excavations where most of the holes are down holes. The type which is in most general use, is the Ingersoll-Rand B.C.R. 33, which weighs about 90 lb., using air at 80 to 90 lb. pressure. The hollow drill steel is usually about 1⅛ in. octagon, the holes are drilled dry, the air through the steel blowing out most of the dust, therefore keeping the holes clean and consequently increasing the effectiveness of the machines. These drills are used for drilling holes to depths up to 12 and 14 ft.; it is stated that they require from 50 to 75% less air at the same pressure than the usual tripod drill does, and only one man is required to operate each of them. The general opinion seems to be that unskilled laborers with very little instruction could use these drills, though, of course, in New York the labor unions compel the employment of regular union drill runners.

On Section 14 (McMullen & Hoff) four men with as many drills were averaging from 80 to 90 ft. of hole per man per day of eight hours. There was one record of 113 ft. for one man in eight hours. It was considered advisable to keep a number of spare drills on hand, so that in case anything went wrong, there was no delay, and any damaged drill could be taken to the shops, where it could be carefully repaired by a competent machinist, even though the trouble was very slight. This was considered to be better than to have an ordinary drill runner try to fix it with the spanner or sledge hammer, the tools usually used by them when anything is wrong with a drill. These drills were also used on the heavy rock excavation of Section 13, a cut 30 to 50 ft. wide and as many feet deep, with excellent results.

On some sections a lighter type of drill weighing about 40 lb. and using about 50 ft. of air per min. is being used; this is the Ingersoll-Rand B.R.C. No. 430 or so called Jackhamer type, used for holes up to 6 and 8 ft. in depth using ⅞-in. hollow steel.

Another point of interest is the almost universal use of machine drill sharpeners, nearly all of which are of the Leyner type. This use of machine sharpeners is possibly due, to some extent, to the use of the hollow steel and the rose-shape form of bit generally used with these hand drills, though of course, it has been shown even with the old type of cross bit, that where the number of drills warranted, the installation of a drill sharpener was an economy.

It was noted that in many cases the heads of the steel drills had sheared square off just back of the head. This type of failure has not previously come to the writer's notice, and no adequate explanation was offered by the men on the work, but it would seem that it might be due to the severe internal stresses set up by the much greater force used in the machine sharpeners in forming the heads, and the fact that possibly in these machine sharpeners, the steel can be, and is, worked at a lower temperature than by hand.

It is stated by the contractors on Sec. 13 and 14 that the general breakage and wastage of steel used is rather greater than with the ordinary steel, and, of course, the hollow steel is more expensive, but it is thought this is much more than compensated by the greater amount of work done. The Leyner drill sharpeners are used to make all the bolts for the timbering on one section, where it was stated that 400 bolts were headed per hour.

Electric current is used for power at most of the compressor plants, and air is usually piped to all points of the work for use in drills, pneumatic riveters, etc. In some cases the air is used for operating hoists and derricks, in other cases electric power is used directly for this purpose; this apparently is governed most generally by the plant the contractor may have had on hand, but the use of air for hoists and derricks, so long as it has to be installed in any event, seems to be the most satisfactory and most generally used.

Various schemes for heating the air during cold weather were noted, some of the apparatus home-made and other manufactured especially for the purpose. On one section (McMullen, Snare & Triest) an upright coil of about 6 to 8 rings, 15 to 18 inches in diameter, was made in the air line near the point where it was to be used, and a fire built and maintained inside the coil. In another case a piece of 6- or 8-in. pipe about 3 ft. long was capped at the ends to take the regular air line (about 2 in.) and a fire built under the larger section. These home-made schemes are probably somewhat wasteful of fuel, but this amounts to very little and they probably stand up better under the rough usage they get on this kind of work than the manufactured heaters.

**An Efficient Method of Resuscitation** has been developed by a committee of eminent physicians and surgeons appointed by the U. S. Bureau of Mines. As a result of a report made by this committee, J. A. Holmes, Director of the Bureau, has recommended first-aid procedure which has the recommendation of successful experience.

The recommendations are of universal application, not only to men who are overcome by electric shock or gases in mines, but also to persons suffering from the effects of illuminating-gas poisoning or from electric shock anywhere.

An abstract of the recommendations follows:

In case of gas poisoning, remove the victim at once from the gaseous atmosphere. Carry him quickly to fresh air and immediately give manual artificial respiration. Do not stop to loosen clothing. Every moment of delay is serious.

In case of electric shock, break electric current instantly. Free the patient from the current with a single quick motion, using any dry non-conductor, such as clothing, rope, or board, to move patient or wire. Beware of using any metal or moist material. Meantime have every effort made to shut off current.

Attend instantly to the victim's breathing. If the victim is not breathing, he should be given manual artificial respiration at once. If the patient is breathing slowly and regularly, do not give artificial respiration, but let nature restore breathing unaided. In gas cases, give oxygen. If the patient has been a victim of gas, give him pure oxygen, with manual artificial respiration. The oxygen may be given through a breathing bag from a cylinder having a reducing valve, with connecting tubes and face mask, and with an inspiratory and an expiratory valve, of which the latter communicates directly with the atmosphere.

No mechanical artificial resuscitating device should be used unless one operated by hand that has no suction effect on the lungs. Use the Schaefer or prone-pressure method of artificial respiration. Begin at once. A moment's delay is serious. Continue the artificial respiration. If necessary, continue two hours or longer without interruption until natural breathing is restored. If natural breathing stops after being restored, use artificial respiration again.

Do not give the patient any liquid, until he is fully conscious. Give him fresh air, but keep his body warm.

Send for the nearest doctor as soon as accident is discovered.

# A Small Slow Sand Water-Filter Plant for the Estate of J. P. Morgan

By John H. Gregory*

The domestic water-supply for Cragston, the estate of J. Pierpont Morgan, at Highland Falls, N. Y., is ordinarily obtained by gravity through a 2-in. pipe from a spring situated on high ground about one mile distant from the main house. For the greenhouses, sprinkling and other miscellaneous purposes, water is obtained, also by gravity, through a 4-in. pipe from an artificial pond, located about 2300 ft. from and about 170 ft. above the main house. For years the spring had supplied sufficient water for all the buildings connected to it, but during a severe drought the spring failed to supply sufficient water and to make up the deficiency, as well as to provide a reserve supply of potable water, a small filter plant was built to filter water obtained from the pond.

The filter plant, which has a capacity of 5000 gal. per 24 hours, consists of two small covered slow sand filters, a regulating house and a clear-water reservoir, and is located about 100 ft. in elevation above the main house and at a point where the 2-in. spring-water pipe and the 4-in. pond-water pipe are in close proximity, so that use could be made of both without laying any additional pipe lines. A general plan and details of the plant are shown in Fig. 1.

The filters, which are each 6 ft. wide by 9 ft. long, have a total filtering area of 108 sq.ft. and are designed to operate at a rate of 2,000,000 gal. per acre per 24 hours. The filter sand was purchased from the city of Albany,

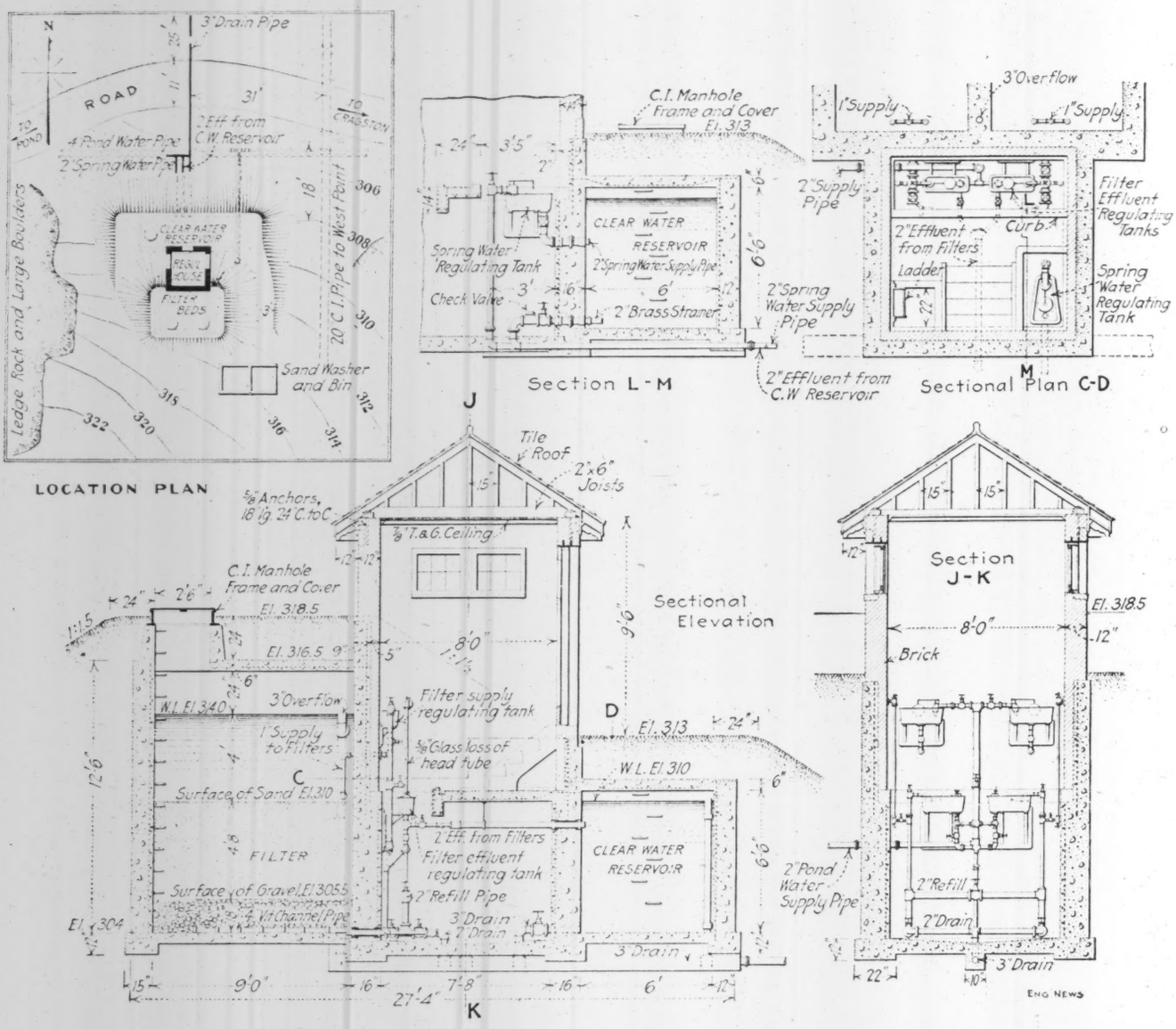


Fig. 1. Slow Sand Water-Filter Plant for the Estate of J. P. Morgan

The filter gravel has a total depth of 18 in., placed in four layers as follows:

| Size | Thickness, In. |
|---|---|
| Coarser than filter sand | 3 |
| 1/8 to 3/8 in. | 3 |
| 1/2 to 1 1/2 in. | 4 |
| 2 to 3 in. | 8 |

from the surplus stock of sand on hand at the slow sand filter plant there, and has a total depth of 4¾ ft. above the filter gravel. The sand has an effective size of 0.31 mm. and a uniformity coefficient of 2.35, with 60% finer than 0.73 mm. The depth of water above the sand is 4 ft.

*Of Hering & Gregory, Consulting Engineers and Sanitary Experts, 170 Broadway, New York City.

The regulating chamber, which is placed between the filters and the clear-water reservoir, is 7 ft. 8 in. square and contains all the piping and apparatus for operating the filters. The chamber is surmounted by a small superstructure built of brick (Fig. 2).

The clear-water reservoir is 6 ft. wide, 20 ft. long and 6½ ft. deep, and with a water depth of 6 ft. contains about 5100 gal., or a little over one day's supply.

Water for the filter plant is drawn from the 1-in. pond-water pipe through a 2-in. pipe connecting with two filter-supply regulating tanks, from which in turn it passes into the filters. These regulating tanks are each fitted with a balanced float valve to maintain a constant water level on the filters and to prevent overflow, as the filters are located at a point about 55 ft. below the level of the pond.

The effluent from each filter passes through a filter-effluent regulating tank, in which a constant level is main-

FIG. 2. REGULATING HOUSE OF SLOW SAND FILTER PLANT

tained by means of a ball cock, the rate of filtration being controlled by an adjustable brass orifice placed in the bottom of the tank. From these tanks the filtered water passes to the clear-water reservoir.

The piping connections to and from the plant are so arranged that the plant can be run in connection with or independently of the spring-water supply and also so that the clear-water reservoir can be used to store spring water when the spring-water supply is sufficient. When running independently the spring-water supply will be entirely cut off. When the spring-water supply is sufficient and the clear-water reservoir is used to store spring water, the filters will be cut off. When used in connection with the spring-water supply, all of the spring water will pass through the clear-water reservoir and the deficiency in spring water will be made up by the filters.

Under this last method of operation, the spring water will pass to the clear-water reservoir through a spring-water regulating tank, fitted with a balanced valve to prevent overflow of the clear-water reservoir. As the draft exceeds the supply of spring water, the water level in the clear-water reservoir will drop and the filters will start up slowly until the maximum rate of filtration is reached. Conversely, as the draft decreases and the clear-water reservoir fills up, the filters will gradually slow down and finally cease filtering when the clear-water reservoir is full.

The filters were designed and built under the direction of Hering & Gregory, Consulting Engineers, of New York, with J. K. Giesey and I. S. Walker as Resident Engineers. The construction work was carried out by Westinghouse, Church, Kerr & Co., of New York, with Howard S. Barton in charge.

## Alloy-Steel Rails

Extensive experiments with the use of special alloy steels for rails have been made during the past few years. But the report presented at the recent annual convention of the American Electric Railway Association by the Committee on Way, states that the production of such rails has decreased materially during the past few years and is now insignificant in relation to the total rail production. The figures are given in Table I:

TABLE I—PRODUCTION OF RAILS OF VARIOUS ALLOY STEELS (GROSS TONS)

| | Openhearth and Electric | Bessemer | Total |
|---|---|---|---|
| 1909 | 13,696 | 35,699 | 49,395 |
| 1910 | 27,389 | 229,935 | 257,324 |
| 1911 | 38,539 | 115,450 | 153,989 |
| 1912 | 40,393 | 108,874 | 149,267 |
| 1913 | 33,567 | 25,952 | 59,519 |

TABLE II. CHARACTERISTICS OF ALLOY STEELS.

| Kind | Steel Containing | General Properties Anticipated |
|---|---|---|
| Titanium | 0.1% metallic titanium | Less segregation, cleaner metal, hence, longer life. |
| Nickel | 3.5% nickel | Increased life. |
| Nickel chrome | Containing varying percentages—nickel and chromium. | Increased life by being tough and hard. |
| Manganese | About 12% manganese | Very tough and hard, cannot be easily cut or drilled, wears slowly. |
| Electric | Made in electric furnace | Very clean steel, free from impurities, thus adding life. |
| High silicon | About 0.35% silicon | Increased life. Much used in England. |

The reason assigned for this decline is the increased cost of alloy steels over that of openhearth steel, which is now being largely used for rails on account of its much higher wearing quality than bessemer steel, although its cost is higher by $2 per ton (or about 7%). The report states that openhearth rails made with the usual addition of 0.1% of metallic titanium, cost about 12% more than bessemer, while with manganese steel at $80 per ton, the cost is about 186% greater than for bessemer steel. As the use of openhearth steel has increased, the use of alloy steels has decreased. This refers to rails for both steam and electric railways. Quoting now from the report:

> The first cost of alloy-steel rails therefore may be not only prohibitive in some instances, but in others so high as to render return on the investment extremely low, especially when a large sum is involved. These matters have doubtless militated against the production of alloyed steel rails, and purchasers have contented themselves with the adoption of openhearth steel on the reasoning that for 7% greater first cost, 50% longer life for the rails might follow.
>
> Under special conditions of quick-wearing track, sufficient benefits may ensue to warrant the adoption of an alloy-steel rail, and the demand for alloy rails seems to be for track of this class. The question of what alloy to use is important. Eliminating matters of cost, the purchaser has ferro-titanium, manganese, nickel, high silicon and electric steel to chose from. It is unfortunate that rail sections are of an intricate and unbalanced character, the girder and high T-rails especially as these odd shapes preclude opportunity for successful heat treatment. However, some attention has been given to the heat treatment of rails.
>
> Experience with alloyed steels is dependent on a number of factors in addition to the metal itself. The mere addition of 0.1% of metallic titanium or 13% of manganese to the steel will not be a panacea for the ills to which track and rails are subject. Reports of breakage and wearing qualities, therefore, are inclined to show divergent results, and even average

results for any particular kind of steel may be greatly exaggerated.

The best tests of rails are those where different kinds of steel are laid in line on the same type of roadway and subjected to equal conditions and maintenance. Results from such experimental track afford good comparison, but the tendency even then is to measure the rail wear by the eye rather than by accurate instruments, so that misleading figures may readily follow.

In the use of alloyed steel on street and interurban lines either the rails have not been in service sufficiently long to permit of a fair comparison being made, or else the matter of careful measurements has been somewhat neglected, so that the records are unsatisfactory. It is opportune to emphasize the fact that girder and high T-rails, as well as standard sections, can be easily rolled from the special steels noted in Table II, possessing the general characteristics mentioned.

# An English Railway Trainshed

*SYNOPSIS—The trainsheds of many large railway stations in England are of types quite distinct from those in use in this country. The accompanying article describes a recent design of a station at Birmingham which consists of transverse girders 275 ft. long, with four supporting columns, spanning the entire width of the station, and having framed between them rows of arch trusses of 36-ft. span. The methods of erection are described also.*

The Great Western Ry., of England, has reconstructed and enlarged its Snow Hill station in Birmingham. The new trainshed is of a type practically unknown in this country. The station is a large one, with a track plan as shown in Fig. 1. Four main tracks run through the center, with a single track on the outer side of the two large island platforms, while at the north end of the station each of these platforms is split by a pair of stub

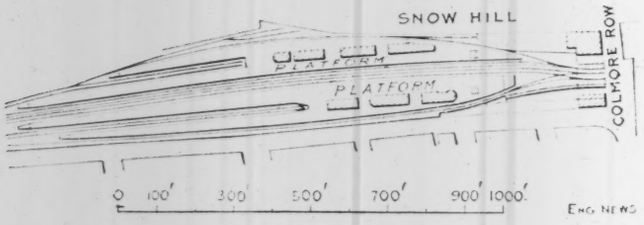


FIG. 1. TRACK PLAN OF THE NEW SNOW HILL STATION AT BIRMINGHAM (ENGLAND), GREAT WESTERN RY.

tracks about 400 ft. long. The two tracks of the longer stub converge to a transfer table (with radial tracks) pivoted at its farther end, so that the engine of an inbound train can be promptly transferred to the outbound track and run around the train. The six through tracks converge into a double-track approach at the south end (in a tunnel) and a four-track approach on a brick viaduct at the north end.*

The main platforms are nearly 1200 ft. long, sufficient for two trains, this arrangement being necessitated by the fact that it was impracticable to widen the station, which is flanked by two streets. Each pair of tracks is connected by a double crossover at the middle, so that with two outbound trains standing on the same track (and heading in the same direction) the rear train can pull out ahead of the other if necessary. In the same way, a second inbound train can pass a train standing at the platform and then run onto the same platform track. There is also a trailing crossover between the two pair of tracks. This arrangement of double-length platforms is a feature also of the Victoria Station of the London, Brighton & South Coast Ry., at London, described in ENGINEERING NEWS, Feb. 11, 1909.

The switches and signals are operated from two towers by the Westinghouse all-electric interlocking system. Current at 110 volts is supplied from a storage battery charged by two motor-generator sets. The main platforms are 81 ft. wide, with 24-ft. clear width on each side of all buildings erected on the platforms for waiting rooms, etc. The spur platforms of the stub tracks are 300 to 500 ft. long, and 12 to 10 ft. wide. All platforms are 3 ft. above the tops of the rails.

## TRAINSHED

This is the most interesting portion of the station from a structural point of view, and its general design is shown in Fig. 2. Across the entire width of the station extend parallel-chord trusses resting on columns in the side walls and on two columns on the main platforms. These trusses are spaced 35 ft. 10 in. apart, and between them are fitted trusses (about 15 ft. apart) having curved bottom chords and inclined top chords, with a monitor roof at the top. Thus the trainshed or station roof consists of a series of transverse ridges, or what is known in England as a "ridge-and-furrow" roof (quite different from the American "saw-tooth" type). The upper part of each ridge, on either side of the monitor, is covered with a skylight.

The long transverse trusses are 8 ft. deep, with chords 12 in. deep and 15 in. wide, as shown in Figs. 2 and 3.

*The swinging transfer table was described in "Engineering News," Aug. 13, 1914.

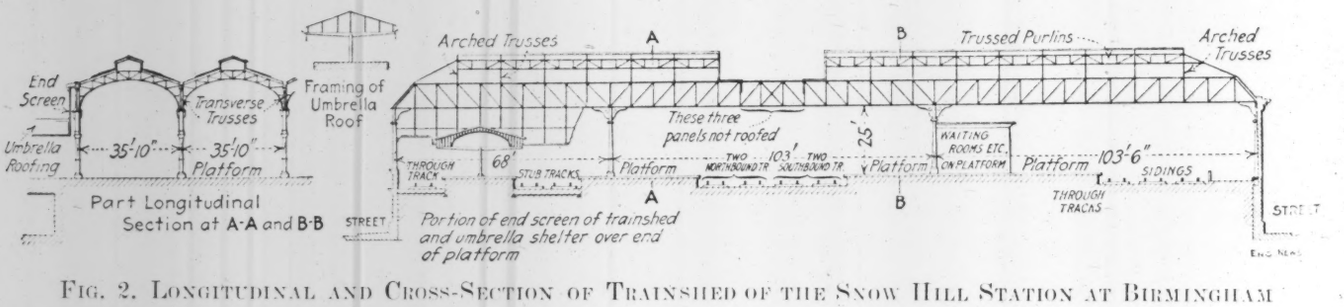


FIG. 2. LONGITUDINAL AND CROSS-SECTION OF TRAINSHED OF THE SNOW HILL STATION AT BIRMINGHAM (ENGLAND), GREAT WESTERN RY.

They are riveted up to form continuous girders, and are rigidly connected to all the four columns, as it was considered impracticable to place satisfactory expansion bearings on the tops of the light columns. The columns are designed, therefore, to take up any tension due to expansion and contraction of the 275-ft. trusses. There are 15 of these transverse trusses, so that the trainshed is 550 ft. long. The north end has a glazed screen, carried about 3 ft. beyond the main end trusses, as shown. The sides or walls also are glazed.

It will be seen from Fig. 2 that the end trusses and roofing are omitted over the five central panels. Two of these panels have a low ridge-and-furrow roof between the trusses, but the other three are left open to the air, thus providing a 22-ft. opening for light and ventilation. This shows also in Fig. 1. Along the south end of the trainshed (facing the headhouse) extends a covered footbridge over the tracks, with stairways to the platforms and inclined walks to the main entrance hall.

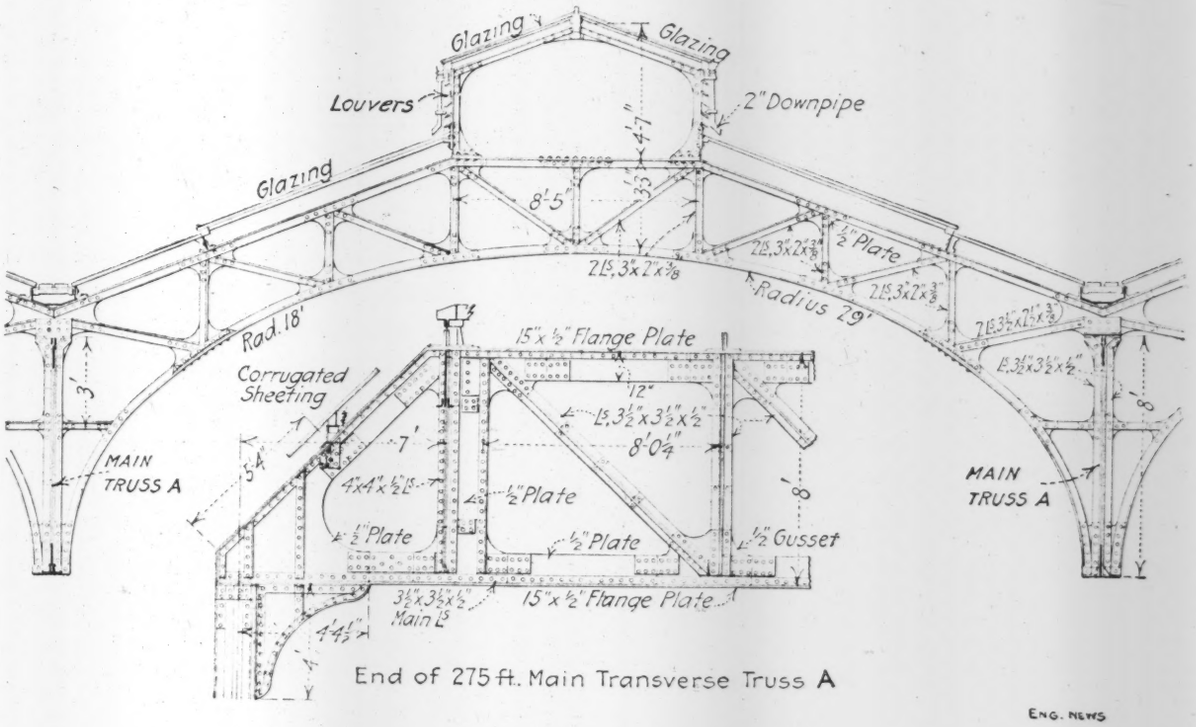


FIG. 3. TRUSSES OF THE NEW TRAINSHED

The arch trusses which are fitted between the main transverse trusses have their ends somewhat deeper than the main trusses, so that the end web members and the top chords of adjacent roof trusses are connected above the top chords of the main trusses. All the members are angles, and all the connection plates are made with curved outlines. A plank walk is placed in each furrow.

FIG. 4. SNOW HILL STATION AT BIRMINGHAM (ENGLAND), GREAT WESTERN RY., SHOWING THE TRAINSHED CONSTRUCTION AND BUILDINGS ON THE PLATFORMS

The platforms extending beyond the north end of the trainshed are covered by umbrella roofs or canopies. Each canopy has a single row of columns, 20 to 33 ft. apart, with a double cantilever arm on which are upright members to support the roof framing, as shown in Fig. 2. The columns are anchored to concrete blocks and are designed to resist a 56-lb. wind pressure. The clear height under the cantilever arms is 11 ft. 9 in., and the width of the canopy roof is from 20 to 38½ ft. The sides extend 18 in. beyond the platforms, and are faced with a wood screen whose lower edge is 13 ft. 6 in. above the rails.

### Erection of Trainshed

The first step was the removal of the old arched roof, which had crescent-shaped trusses with both chords curved. Beneath this was erected a traveler having three

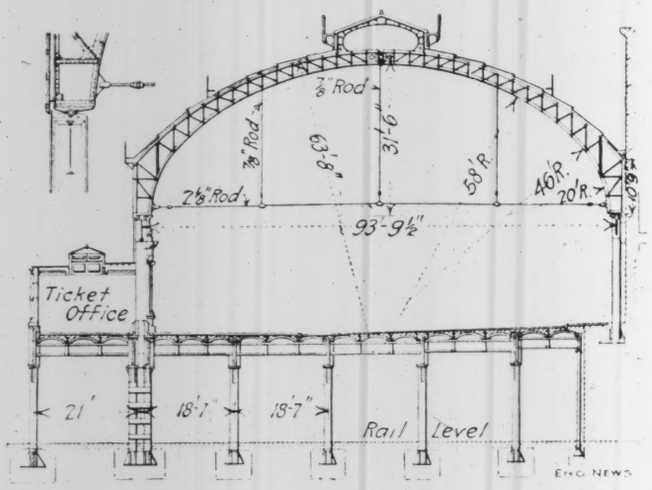


Fig. 5. Cross-Section of Main Entrance Hall, with Three-Hinged Arched-Roof Trusses

timber trusses with curved top chords carrying a curved deck that fitted close beneath the bottom chords of the old roof trusses. The ends of the traveler trusses were carried on timber towers with double-flanged wheels riding on rails.

For the erection of the new trainshed, the two end portions of each main truss (extending from the wall columns to the interior columns) were shipped and erected complete; except that four of maximum length (105 ft.) were shipped in two parts and riveted up on the floor before being hoisted into place. The 103-ft. length of the center portion of each truss (between the interior columns) was shipped in two (or three) sections and assembled in place. These 103-ft. lengths were erected from a traveler having a track for a 7-ton locomotive crane of 18-ft. working radius.

The traveler had three 95-ft. lattice trusses 9 ft. 6 in. deep, 25 ft. apart, connected by lateral bracing and carrying I-beam joists and a plank deck. The ends of this structure were supported by trestle towers on rails, the towers being spaced 73 ft. c. to c. Pneumatic riveting hammers were used. The steel was shipped and erected unpainted. The dirt and mill scale were then removed with wire brushes, and after two coats of red lead, two finishing coats of paint were applied.

### Arched Roof of the Entrance Hall

The main hall or entrance hall is about 93x165 ft., with a barrel arch roof composed of three-hinged arch trusses of 94-ft. span, 31½-ft. rise. On one side these rest on a latticed truss supported by two end columns. The height from the floor to the springing line is 22 ft.

This roof is shown in Fig. 5. The radius of the bottom chords is from 20 to 58 ft. The feet of each truss are connected by a tie rod, but instead of being attached to the shoe pins, the looped ends are attached to pin plates on the face of the bottom chord. The tie-rods have turnbuckles for adjustment, and to prevent sagging each rod is supported from the arch by three ⅞-in. hanger rods. There are seven of these arches, connected by trussed purlins. Above the arches is a wide monitor roof.

In erection, each arch was delivered in four sections. Each half arch was then assembled, riveted up, and raised by a derrick having a 75-ft. boom. This derrick held it in place until the other half was swung in the same way and the hinge pins were fitted into position.

### Other Features of the Station

The Snow Hill station is built on sideh ll ground and the adjacent streets are of varying levels and grades. The tracks are elevated above the general street level, the lower floor being utilized for station facilities and for stores fronting on the two side streets which limit the width of the station. At the south end, however, a main street crosses the tracks, and the main entrance is from this street so that the main passenger facilities are at this upper level. This street is reached by inclines from the two side streets. The hotel above the tracks has been converted into an office building for the division officers of the railway, with the main restaurant on its lower floor.

The main entrance hall is behind this building, having a 20-ft. approach corridor from the street, while on the west side is the carriage entrance, with a driveway extending into the hall so that passengers are landed close to the ticket office, baggage room, parcels room, etc. From this main hall, two inclined walks lead to a covered footbridge 20 ft. wide, across the end of the trainshed, with a 24-ft. stairway to each platform. The entrance hall is about 90x165 ft., and is carried by heavy plate-girders which give a clear headway of 14 ft. 3 in. above the rails. It has a barrel arch roof as described above.

One feature which is in marked contrast to American practice is that there is no spacious and elaborate general waiting room. Instead, separate and relatively small waiting rooms (for the different classes of passengers) are provided upon the two main platforms in one-story structures of brick and stone. Similar buildings contain the refreshment rooms, telegraph offices, toilet rooms.

The design and construction of the new station was under the direction of Mr. Armstrong, Engineer of New Works, Great Western Ry. The general contract was let to Henry Lovatt & Co., and the steelwork was built and erected by E. C. & J. Keay.

**Railways of Queensland, Australia,** according to the report of the Commissioner for the year ending June 30, 1914, aggregate 4700 miles, of which 189 miles was open to traffic during the year. Railway lines amounting to nearly 300 miles are under construction, and over 1400 miles have been authorized by Parliament but are not yet begun.

# Municipal Ownership and Operation of Water-Works*

By M. N. Baker†

The rapid growth both in the number of water-works and in the percentage of those works under municipal ownership was one of the marvels of the nineteenth century. The century opened with 16 works in the United States, only one of which was municipally owned. It closed with perhaps 3500 works, more than half of which were under public ownership and 200 of which had changed from private to municipal ownership. No statistics of ownership for the whole United States have appeared since "The Manual of American Water Works" for 1897, but it is known that changes from private to public ownership have gone on at a rapid pace in the last 17 years and it is believed that of the hundreds of new works built in that period the greater part are now owned by the city which they supply.

All of the major cities of the United States own their water-works until San Francisco is reached. Going over the whole list of cities which the Census Bureau estimates as having a population of 30,000 population and upwards it appears that in round numbers there are 150 municipal to 50 private plants, or 3 public to 1 private. If total populations supplied were considered, the preponderance of municipal ownership would be still greater.

Competing water companies have been few. Competing municipal and private works have been fewer still and such competition ends, sooner or later, with the city in full possession of the field. The reason for this lack of competition is that the water-supply service is one of the most complete natural monopolies in existence.

This natural monopoly feature and the close and vital relationship of public water-supplies to the health of water consumers and to the safety of both life and property from fire, go far toward explaining the rapid growth of municipal ownership of water-works and the persistent demand for a change from private to public ownership where the former prevails. It does not follow, however, that every city still under private ownership is in duty bound to acquire works of its own without delay. A variety of local conditions may determine the wisdom of continued private ownership for a few or even for many years. Good service under private ownership is increasingly possible each year, because the newer water-works franchises and contracts are more definite and fairer to each side than the older ones and because of the growing prevalence of state utility regulation. Nevertheless, no matter how far in the future matters of local expediency may throw municipal ownership it may well be the ultimate goal of every city, town and village that has not yet attained it.

Notwithstanding all that has been said and so well said in favor of home rule, I still believe, as I have long believed, that municipal as well as private water-works should be subject to state regulation. Even if in no other respect, there must be state regulation of the purity of the supply. This principle was recognized and put into effect in a number of states before state regulation of utility rates was thought of. Until recently, state regulation of the sanitary quality of water-supplies was always vested in state boards of health and with one or two partial exceptions this is still true.

The case for state control of the purity of water-supplies rests upon the fact that public health is a matter of state and national concern and cannot safely be left to local control. A city with a polluted water-supply does not stop with causing a high local typhoid rate—though this in itself is a proper matter for state interference. Such a city contributes in numberless ways to the spread of typhoid throughout the whole state and over the whole country.

Besides the question of purity, state control of water-supplies, regardless of ownership, is demanded to settle rival claims for sources of supply which two or a half-dozen cities may wish to draw upon. This matter is now being controlled by state boards of health in some states and by state water or state conservation commissions in others, but not often, if at all, by state utility commissions.

If time permitted I should like to present in detail the argument for state control of water-works accounts and reports of physical data. Where such control is now exercised, it is vested sometimes in a state board or commissioner or auditor of municipal accounts and sometimes in a state utility commission.

Coming to another phase of the subject, I believe that it would be salutary if there were some measure of state control over the way in which a city raises its money to defray the cost of its utility service. In the case of water-works, in particular, rank injustice now prevails in the distribution of the cost of the service between the private consumer and the city at large. I believe the Wisconsin Commission has taken a long step in the right direction in compelling some cities to raise by taxation an adequate sum to pay for fire protection and other public services instead of saddling this charge upon the private consumer. The whole water-works fraternity of the country has for years urged that the taxpayer and not the private water consumer should meet the cost of fire protection, street watering, sewer flushing and the water-supply to public buildings.

Possibly some of you may have observed that such instances of state regulation of water-works as I have specified are vested in four independent commissions: (1) health; (2) water-supply or conservation; (3) utility; (4) accounting or auditing—and there may be still others. Some of these commissions have overlapping jurisdictions. Strongly as I believe in state administrative control of municipal affairs, I do not wonder that there are complaints of over-regulation when there are so many municipal masters—although even a multiplicity of state administrative boards is infinitely better than the old-time state legislative interference which these boards are lessening.

Distasteful as any sort of state control may seem to some, cannot we all agree upon the desirability of placing all such control as may from time to time exist under one instead of many commissions—a single State Board of Municipal Control, under which there would be a bureau for each branch of the municipal service subject to state supervision, the whole working in harmony and so centralized in administration as to give one instead of many municipal masters?

*An address before the Conference of Municipal Mayors on Public Policies as to Municipal Utilities, Philadelphia, Penn., Nov. 14, 1914.

†Editor of "Engineering News," New York City.

# The Hell Gate Bridge in the Shop

Progress in building the Hell Gate Bridge across the Narrows of the East River between Long Island City and Ward's Island is in accordance with schedule. The steelwork of the 977½-ft. steel arch has been in course of fabrication at the Ambridge, Penn., plant of the American Bridge Co. since early this year, and in May was begun the yard assembly of portions of the arch, which is required in order to make the joints true and assure accurate and easy fit in field erection.

Meanwhile, the work at the site has been advanced, after completion of the piers, by beginning the erection of the towers and temporary backstays which are needed for the erection of the arch by the cantilever method. The program is based on finishing both the backstays during winter, so that erection of the arch itself can be started at the earliest possible time in spring, 1915, and thus give the whole season for erecting and swinging the arch.

A full description of the Hell Gate steel arch, with drawings of typical parts of the steelwork, will be found in ENGINEERING NEWS of Jan. 8, 1914, pp. 59 to 64. The vital features of this bridge from the standpoint of the shop which must fabricate the steelwork are:

(1) The use of high-strength medium steel throughout. The demanded ultimate tensile strength is 66,000 to 76,000, with a desired value of 71,000 lb. per sq.in. The material must meet a cold-bend test of 180° around a diameter of twice the thickness.

(2) The enormous size of the individual members and of the plates which compose it; and more especially the size of gusset-plates.

## HIGH-STRENGTH CARBON-STEEL

The steel at first furnished under this contract ran generally down toward the lower limit of the demanded strength-range, that is, near 66,000 lb. With further efforts, however, the deliveries were of stronger material, and at the present time the average of the tests runs rather over the required average, probably near 72,000 lb. per sq.in. The carbon content of the material varies, to suit the thickness of material (ranging from ½ in. to 2 in.). The ordinary amount is in the neighborhood of 0.40%.

## LARGE SIZE OF PARTS

Some of the most difficult pieces to furnish are the large gusset-plates, extending through the entire depth of the lower chord or arch rib and projecting up to take the web members. The largest such plate is 122 in. wide by 17 ft. long, and 1⅝ in. thick. Some of the 2-in. web-plates, 62 in. wide, are heavier, but the large gusset mentioned is at the extreme limit of the capacity of available rolling mills. Doubt was entertained from the start by the shop people whether these large plates would be obtained reasonably straight (flat) and of uniform thickness; i.e., without swell in the middle of the width. Overrun of thickness would make trouble in entering the gussets into the slots in the chord which receive them (see Fig. 4, where the slots are seen just outside of either web-plate; in Fig. 3 a shallower slot is seen, this being the end of the arch rib which is seated on the shoe).

## YARD-ASSEMBLY

The fabricating processes on this steelwork are unusual not only because of the conditions just mentioned but also because of two other requirements: that practically all the holes must be drilled (subpunching is allowed only in ½-in. and less thickness), and that the structure must be assembled in the yard and the field connections drilled to match before the parts are shipped. This last requirement is reflected in the accompanying views, Figs. 1 and 2.

As might be expected from the great size of the structure, it was not possible to yard-assemble the entire arch (i.e., one truss) simultaneously. The assembly of three or four panels at a time was, therefore, taken as satisfactory, but the terminal members of each section are later reassembled with the following section to get the match of the connection.

The view, Fig. 2, pictures the four end panels of the arch; the endpost is the farthest member in the view, the upper chord is at the right, and the lower chord or main arch rib is at the left. In Fig. 1 the lower chord is the farther member and the endpost is at the right.

## POLYGONAL-FACED CHORD JOINTS

Planing the chord joints is one of the special features of the work, in view of the great size of the parts. This work is done on a traveling-head planer, housed in the shed at the right in Fig. 1 and in the background in Fig. 2. Only one end of the member being planed is in the house, the larger part of the length being outside. The roof of the planer house is removable, so that the yard gantry can lift the piece away or turn it, as may be needed.

This yard gantry was built specially for the work in hand. It is 130 ft. in span and has a capacity of 150 tons, although it will be called upon to lift loads of about 185 tons, which its normal overload capacity permits it to handle.

The main arch rib is of the section exhibited by the piece in the planer in Fig. 1, a box section with horizontal diaphragm at mid-height. The width of the section is 7 ft., and its depth varies from about 7½ ft. at the crown of the arch to 10½ ft. at the abutments (the face shown in Fig. 3). This rib is field-spliced at each panel-point; the joint faces are planed to a polygonal contour, which gives contact over only the middle third of the depth of the section, while the upper and lower thirds are backed off on a taper amounting to $\frac{1}{16}$ in. each at upper and lower flanges. Thus, when the two adjoining sections are butted together in correct relative position, there is an opening of ⅛ in. at top and bottom, with the middle third of the depth in true bearing.

The original requirement of the engineer was that one of the abutting faces should be finished to a slight circular or rocker curve, the other face being plane; but this requirement was, upon consultation with the contractor, modified to give the polygonal outline just described.

In facing the first rib sections fabricated, early the past summer, they were planed on the true joint planes for the full depth of the section, and the first yard assembly was done with the rib sections in this condition. The purpose was to see whether joints could be obtained so true and accurate as to make the polygonal planing unnecessary. On assembling, it was found that the joints made perfect contact. However, the engineer preferred to make still more certain of uniform stress distribution

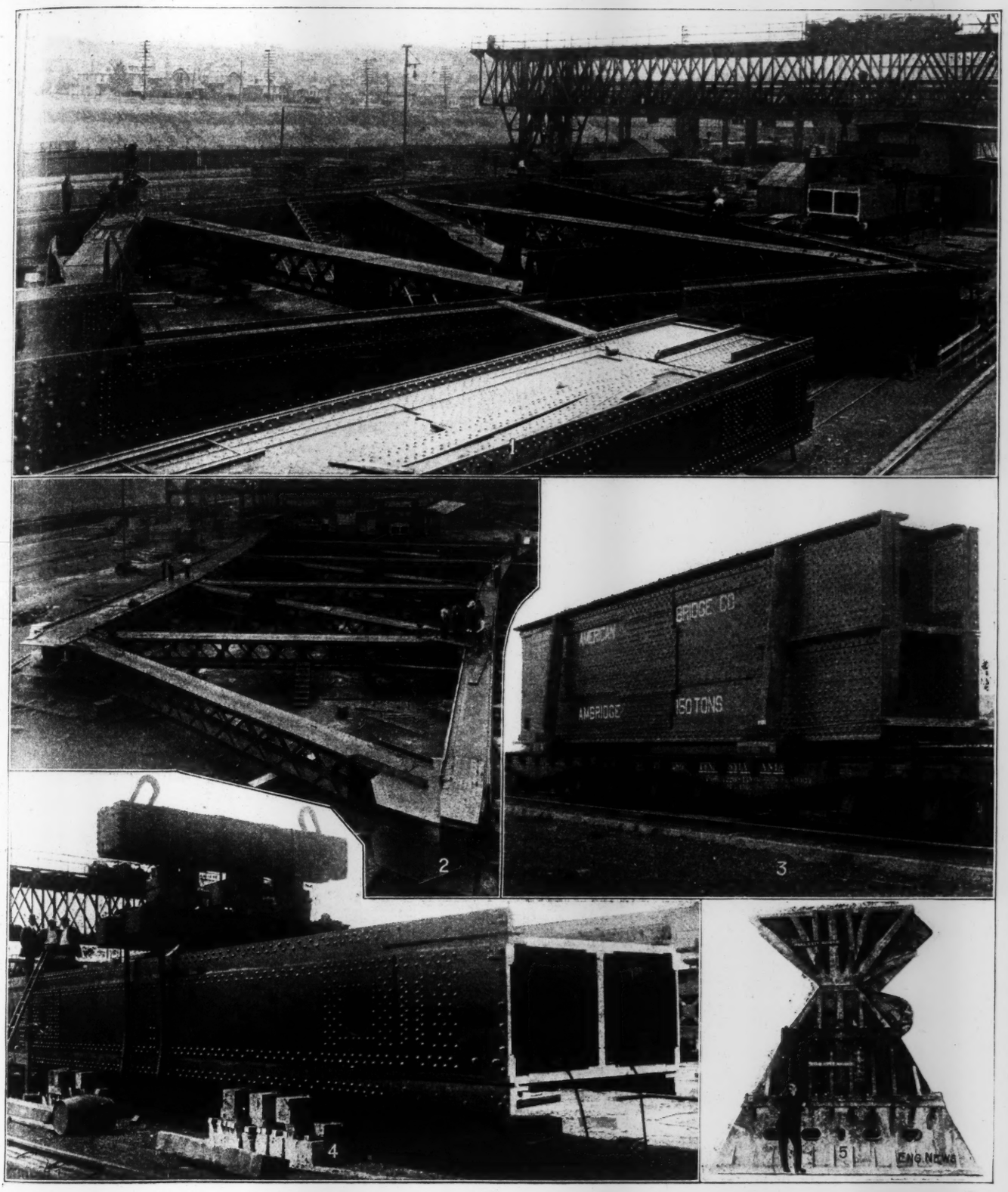


FIG. 1. END SECTION OF ARCH ASSEMBLED IN AMBRIDGE SHOPYARD

(Top chord in foreground, end-post at right; at extreme right, under the 150-ton yard gantry, is the planer house, with a bottom-chord section in place for planing the joint face.)

FIG. 2. ANOTHER VIEW OF THE FOUR-PANEL PIECE OF THE ARCH ASSEMBLED IN THE YARD

(The joint in the right foreground is one of the top-chord panel-points, which have much smaller gusset-plates than those of the bottom chord.)

FIG. 3. END SECTION OF BOTTOM CHORD, ON CARS FOR SHIPPING

(Weight as stripped for shipping, 150 tons; weight with gussets, etc., 185 tons.)

FIG. 4. ONE OF THE BOTTOM-CHORD SECTIONS IN THE YARD

(Note special lifting shackle. The end of the member shows the slots in which the web gussets must be entered to full depth of chord, during erection.)

FIG. 5. END SHOE OF HELL GATE ARCH

by adhering to the original requirement of backed-off outline.

EXCELLENT SHOP WORKMANSHIP OBTAINED

The drilling of rivet holes is distinctly slower in the medium-carbon steel of this bridge than in normal structural steel; with this exception it may be said that the material works just as easily as any bridge steel. Both the bridge-works officials and the engineer for the bridge say that the shop operations and the workmanship of the finished parts have been in all respects satisfactory. The rivets in the principal members of this bridge are of 1¼-in. diameter. These are practically identical in material and strength with ordinary bridge rivets.

The group of views also contains a view of one of the end shoes of the arch. Such a shoe built up of steel castings with 4-in. metal thickness weighs 500,000 lb. Inasmuch as it sits on a masonry seat inclined about 45° to the horizontal, provision was made for anchoring it in place until the arch is so far erected that the thrust of the structure will hold the shoe securely to its seat. Ears have therefore been cast on the upper member of the shoe, as will be seen in Fig. 5. These will be linked to eye-bars built horizontally into the pier masonry just above the shoe level. After completed erection of the arch, the pins connecting the ears to the eye-bars will be removed, the eye-bars cut off close to the masonry, and the omitted blocks of facing stone at the location of the eye-bars will be set in place.

The end casting of the arch, shown in place on the shoe, has a slightly convex cylindrical face, to give hinge action. A dowel connects the hinge castings to prevent displacement transversely.

The American Bridge Co., who is fabricating the steelwork, will also erect the arch, and is at present erecting the backstays, already mentioned. Gustav Lindenthal, 68 William St., New York, is engineer for the owner, the New York Connecting Railroad Co.

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# A Year of Commission-Manager Government at Lakeland, Fla.

BY DONALD F. MCLEOD*

The commission-manager government of Lakeland, Fla., the first of its type in the state, came into power in January, 1914. There was no great demand for the commission form of government in Lakeland, only a small vote was polled, and the majority was small. As a consequence, the new form of government has not had a strong backing of public opinion to encourage its efforts for efficiency in public service. Moreover, there has been considerable active opposition. This, at one time, took the form of a largely signed recall petition, which was eventually withdrawn. In spite of lack of support, the first year of the new government has not been barren of favorable results, as will be shown by mentioning some of the changes and improvements made in the various departments of the city:

THE SANITARY DEPARTMENT—This department looks after garbage collection, street cleaning and cleaning outdoor closets. Though the city has a population of probably less than 8000, the building lots are large, many of them having frontages up to 135 ft., and the limits include an area of about 4 sq.mi. The central part has modern sewerage, and a sewage-disposal system with Imhoff tanks. The care of the outdoor closets outside of the sewer zone, and the collection of garbage from the area of 4 sq.mi., constitute the most important duty of the sanitary department.

The following improvements have been made: A general cleaning up of all the alleys; the connecting up of a large number of buildings with the sewers; substitution of quicklime for antiseptics in outdoor closets instead of expensive coal-tar derivatives; a saving of $85 per month by having the head of the sanitary department take over the plumbing inspector's duties in addition to his own; a reduction of about $40 per week in the labor payroll; prompter and more reliable collection of garbage; introduction of "white wings" cleaning on the business streets; changes in the plumbing code, providing for the examination of all plumbers before granting them licenses, and putting all plumbers under bond to the city.

THE STREET DEPARTMENT—The business section is paved with brick and part of the residential section with bituminous concrete, but there is a large extent of sand-clay streets and unpaved roadways. As the cleaning of the paved streets is done by the sanitary department, the principal work of the street department is the maintenance of the sand-clay and unpaved streets. The split-log drag has just been introduced, and is found of great service. The street department has been given, lately, the repair work on paved streets necessitated by the trenching operations of plumbers and others, the cost of the work being charged to those doing the trenching.

FINANCE DEPARTMENT—A budget system of twelve divisions has been developed, instead of the old method of throwing everything outside of the light and water fund into a general fund and a sinking fund. Part of the floating debt due to the old system is being taken care of in the first budget of the new system, which, if carefully adhered to regarding expenditures in the different divisions, will clear off the floating debt in a few years.

FIRE DEPARTMENT—Improvements have been made in the present alarm system by putting in an extra telephone, connected with a large gong, and by having a direct connection from the telephone at the water-works pumping station to the fire whistle. The citizens have voted to secure money to put in a modern noninterfering box fire-alarm system, a pumping engine, and other apparatus.

POLICE DEPARTMENT—The following improvements have been made in the police department: Patrolmen are required to report their whereabouts to headquarters half-hourly by telephone; data concerning all arrests are entered on printed forms by the patrolmen at the time of the arrests.

WATER AND LIGHT DEPARTMENT—The citizens have voted to sell bonds to enlarge the present overloaded power house and to extend and meter the water-distribution system. This enables the department to lower the rates to consumers, as a large part of the revenue has been expended, previously, in installing new mains and other relatively permanent parts of the distribution system. A commencement in lowering the rates has been made by cutting the minimum charge for water to $0.75 per month and for light to $1 per month, as against $1 and $1.50 per month for water and light, respectively. Further reductions will be made, because now only the interest on

*City Manager, Lakeland, Fla.; Associate Member American Society of Civil Engineers.

permanent improvements will be paid from revenue, outside of small payments on a sinking fund.

There have been large losses in the past through customers neglecting to pay bills when they changed their places of business or residence. This has been largely obviated through prompter rendering of bills, and discontinuing service to delinquents.

## Long-Term Variations in Stream Flow, Croton and Hudson Rivers

By Edward H. Sargent*

The writer has made an investigation of the two longest stream-flow records in New York State, the Croton River (1868 to 1913) and the Hudson River (1888 to 1913), with an idea of finding their diversity of flow.

On the accompanying diagrams (Figs. 1 and 2) are shown Duration Curves† for the Hudson River at Mechanicville (drainage area 4500 sq.mi.) and the Croton River at New Croton Dam (drainage area 360.4 sq.mi.). Curves are given for both places for the long-term record, the driest‡ year, the wettest‡ year, and the last five years, 1909 to 1913, inclusive.

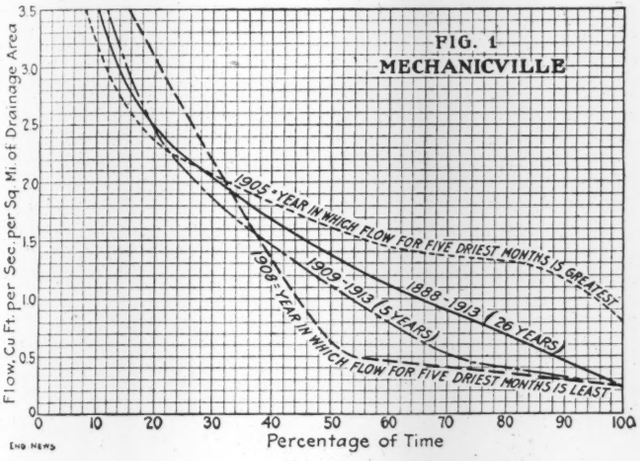
FIG. 1
MECHANICVILLE
Flow, Cu.Ft. per Sec. per Sq. Mi. of Drainage Area
Percentage of Time
1905 - YEAR IN WHICH FLOW FOR FIVE DRIEST MONTHS IS GREATEST
1888-1913 (26 YEARS)
1909-1913 (5 YEARS)
1908 - YEAR IN WHICH FLOW FOR FIVE DRIEST MONTHS IS LEAST
ENG NEWS

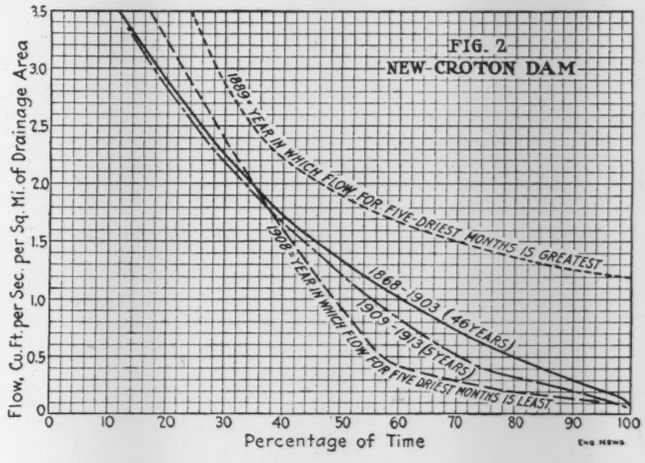
FIG. 2
NEW-CROTON DAM
Flow, Cu.Ft. per Sec. per Sq. Mi. of Drainage Area
Percentage of Time
1889 - YEAR IN WHICH FLOW FOR FIVE DRIEST MONTHS IS GREATEST
1868-1903 (46 YEARS)
1909-1913 (5 YEARS)
1908 - YEAR IN WHICH FLOW FOR FIVE DRIEST MONTHS IS LEAST
ENG NEWS

Duration Curves of Flow of Hudson and Croton Rivers

(Based on monthly records at Mechanicville and at New Croton Dam.)

The Mechanicville curves are based on the records taken at the plant of the West Virginia Pulp & Paper Co. and represent the combined wheel and spillway discharges, which have been checked at various times by current-meter measurements. These flows do not represent exactly the natural runoff from this watershed because of the diversion of approximately 200 cu.ft. per sec. to the Champlain Canal during the navigation season, May 1 to Dec. 1. The natural flow since 1899 has also been somewhat modified by the storage in the Indian River Reservoir, 4,700,000,000 cu.ft. capacity. In view of this storage it is pertinent to note that the driest year (1908) during the entire period 1888 to 1913 was subsequent to the construction of this reservoir. The wettest year (1905) subsequent to the construction of this reservoir was but slightly in excess of the wettest year (1892) prior to its construction.

It was found that to obtain a duration curve for recent years that would closely approximate the low-water portion of the long-term duration curve at Mechanicville, it was necessary to use the records for the last eleven years. In any duration curve computed for any series of years from 1913 backward less than eleven years, the curve will lie below the low-water portion of the long-term record curve.

The Croton River curves were based on the computed natural flows of the Croton River at the New Croton Dam. The estimates of the flows from 1868 to 1899 were made by John R. Freeman, and from 1900 to date, by the Croton Aqueduct Commission and the Department of Water Supply, Gas and Electricity of the City of New York.

The driest year of the Croton River records was 1908, coinciding with the driest year shown by the Mechanicville records. The wettest year shown by the Croton River records was 1889. Similarly, as in the case of the Mechanicville records, it was found that if a duration curve was computed and plotted from the records of the Croton River for the last eleven years (1903 to 1913, inclusive) it would closely coincide with the low-water flow portion of the long-term record, and any duration curve for any series of years from 1913 backward less than eleven years would lie below the low-water portion of the long-term record curve.

The following is a table of the rainfall on the Croton watershed for the various periods for which the duration curves are shown:

| Period | Rainfall, in. |
|---|---|
| 1868-1913 | 48.82 |
| 1903-1913 | 49.22 |
| 1909-1913 | 47.43 |
| 1908 | 43.02 |
| 1889 | 55.70 |

Rainfall stations have only recently been established on the Hudson River watershed at points which will give an idea as to the precipitation at the higher altitudes, so that it is not possible to determine with a great deal of accuracy the rainfall for the Hudson River watershed.

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†See article on "Stream Flow Studies" by the writer in "Engineering News," April 23, 1914.

‡The "wettest year" has arbitrarily been defined as that year in which the runoff for the five driest months was the greatest, and correspondingly, the "driest year" as the year in which the flow for the five driest months was the least.

**Dock Facilities at Guayaquil, Ecuador,** are such that most of the unloading is done by lighters. This, however, appears to be partly due to the fact that it is necessary, or at least advisable, for ships to keep away from the docks in order to lessen the danger of infection by bubonic-plague rats.

# Flood-Protection Work on Fall Creek at Indianapolis, Ind.

By L. F. Wertz*

The work of providing for flood protection along Fall Creek began while the 1913 flood was at its crest.† At that time high-water elevations were taken at each of the 12 bridges crossing the creek and at all points around the flooded district. The former figures were used in connection with establishing the grade and cross-section of the stream, while the latter were used in making a flood map, which was used as a basis for determining the assessments to cover the cost of constructing the new boulevard embankment. The elevations and conditions at the bridges are given in the accompanying table. Fig. 1 is a map of the park district along the creek and shows the new work.

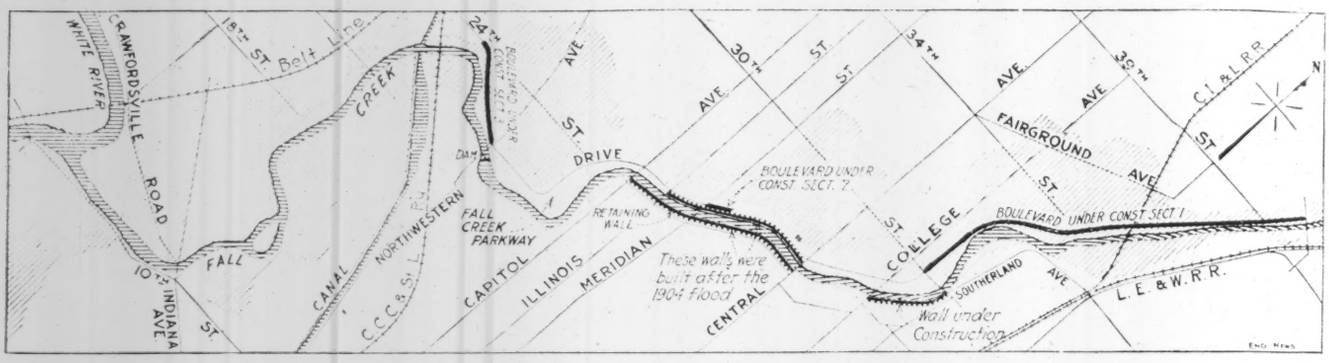



Fig. 1. Map of North Park District, Showing Flood-Protection Work along Fall Creek, Indianapolis, Ind.

FLOOD-WATER OBSERVATIONS ON FALL CREEK, INDIANAPOLIS, IND.

| Place | H.w. elev., Mar., 1913 | Dist. | Diff. in elev. | Slope |
|---|---|---|---|---|
| L. E. & W. Ry. bridge | 724.79 | .... | .... | 0.00126 |
| Fair Grounds bridge | 722.42 | 1800 | 2.37 | 0.00126 |
| Monon Ry. bridge | 717.37 | 3500 | 5.05 | 0.00144 |
| Thirtieth St. bridge | 713.01 | 4700 | 4.36 | 0.00093 |
| College Ave. bridge | 710.82 | 1100 | 2.19 | 0.00199 |
| Central Ave. bridge | 710.70 | 2000 | 0.12 | 0.00006 |
| Meridian St. bridge | 708.87 | 2300 | 1.83 | 0.00080 |
| Illinois St. bridge | 708.09 | 700 | 0.78 | 0.00111 |
| Capitol Ave. bridge | 708.06 | 500 | 0.03 | 0.00006 |
| Northwestern Ave. bridge | 705.50 | 4200 | 2.56 | 0.00061 |
| Big Four Ry. bridge | 703.93 | 2700 | 1.57 | 0.00058 |
| Indiana Ave. bridge | 699.96 | 7300 | 3.87 | 0.00053 |
| Quantity = 25,000 cu.ft. per sec. | | Total 30,800 | Total 24.83 | Average 0.000851 |

Immediately after the flood a survey of the creek was made, extending from its mouth to a point eight miles up stream. This survey was made with transit and stadia, and cross-sections of the stream were taken at 100-ft. intervals. These sections were plotted and were found to range from 2800 sq.ft. to 6000 sq.ft. in area. Some of the sections are shown in Fig. 2. One section (A, in Fig. 2) between the Fairgrounds bridge and the L. E. & W. R.R. bridge carried all the water that passed down the creek. This section contained 4100 sq.ft., with 2900 sq.ft. in the channel proper, and with a stream grade of 0.1%. From these data a maximum flow of 25,000 cu.ft. per sec. was computed. In determining the necessary cross-sections to provide for future floods, the foregoing 4100 sq.ft. section was used as a criterion.

If the grade and section of the channel had been uniform throughout, naturally a 4100-sq.ft. section would have been required at all sections; or if the cross-section had been uniform and the grade had been variable, the velocity, and consequently the flow, would necessarily have changed. But as both the cross-section and grade were variable, both factors had to be considered in establishing the new grade and section of the channel in order to get as nearly as possible a uniform flow.

Another factor that entered into the question of uniform flow was the capacity of the different bridges and the effect of the Indianapolis Water Co.'s dam at Northwestern Ave. The top of the dam is level with the bed of the stream at a point half way between Central Ave. and College Ave. (see Fig. 1), and this last named point is 8 ft. below the bed of the stream at the Fairgrounds bridge.

If the Board of Park Commissioners were to dredge to a depth of 8 ft., the dam would back the water to the Fairground bridge. This being the case, at flood stage the stream grade would be practically 0.1% and uniform. Then with a section of at least 4100 sq.ft., there would be no doubt as to the efficiency of the channel; the only question would be as to the waterway of the bridges. After the creek has been dredged, all irregular-

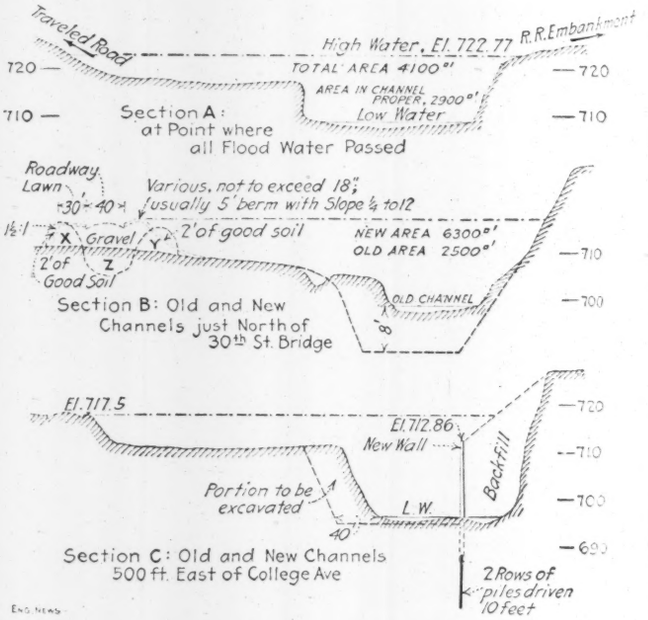



Fig. 2. Cross-Sections of Fall Creek, Showing Improvements

*Engineer, Department of Public Parks, Indianapolis, Ind.

†The flood damages along Fall Creek and White River, in the city of Indianapolis, during the extensive floods of March, 1913, were described and illustrated in "Eng. News" of Apr. 10, 17 and 24, 1913. The reconstruction and protective work along Fall Creek is being done by the Department of Public Parks, a boulevard and parkway being established along each side of the stream. The bridge-repair work will be done by the city.

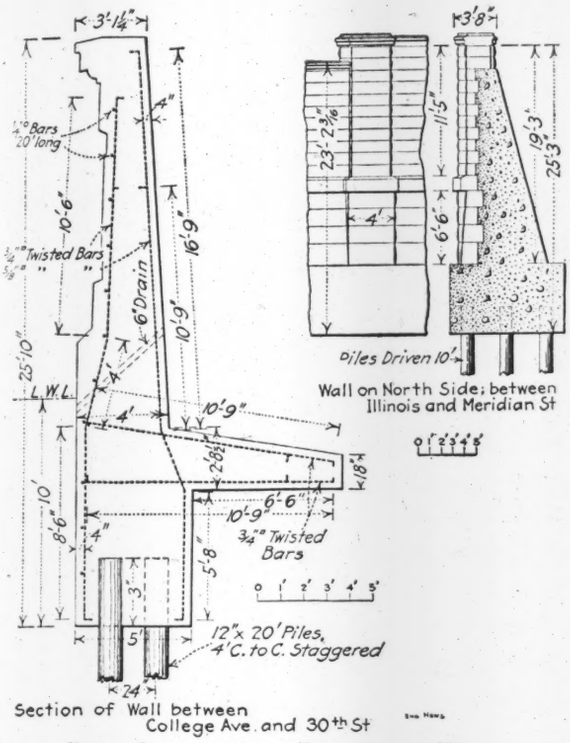

Piles Driven 10'
Wall on North Side; between Illinois and Meridian St
12"x 20' Piles, 4' C. to C. Staggered
Section of Wall between College Ave. and 30th St

FIG. 3. CROSS-SECTIONS OF RETAINING WALLS ALONG FALL CREEK

ities in the bed will tend to be removed and those bridges not resting on piling will be endangered. However, a minimum section of 4100 sq.ft. has been adhered to, and the Board of Park Commissioners will dredge to a minimum depth of 8 ft. and a maximum of 16 ft. As the 1913 flood water all passed through the Illinois St. bridge, having a waterway of 2825 sq.ft., and on a section of the stream whose grade is 0.01% at that point, a sectional area of 4100 sq.ft. seems to be ample.

The first thing in the construction of the boulevard was the removal of the good soil from beneath the proposed roadway, and the storage of it on either side so as later to be available for surfacing the lawns. This is shown in section *B*, Fig. 2. The portion *Z* was removed with slip and wheeled scrapers, and stored at *X* and *Y*. Then the gravel excavated from the creek was hauled in to make the roadway and fill; when this work is nearly up to grade, the material at *X* and *Y* will be brought to the finished cross-section and grade.

The fill for sections Nos. 1 and 3 (Fig. 1) is being made from excavations from the creek, while that for section No. 2 is being made from material obtained from the grading of streets, excavations from cellars, etc. Along sections 1 and 3 the channel will be excavated to a depth of 8 ft. minimum and 16 ft. maximum and will have at least a 100-ft. base width at right angles to the center line of the stream. Section No. 1 is being constructed by the use of four stationary dragline excavators, stationed at intervals along the work. The material is dredged from the creek and dropped into small dump cars, which operate along the line of the work. These dump cars are pulled by an automobile mounted on car wheels, and a trip forward and back can be made in a very short time.

Where the sand and gravel taken from the creek is in excess of that needed for the embankment, it is stored and sold. The cost of constructing this section is about 12c. per cu.yd.

Section No. 3 is being constructed by the use of one dragline excavator and two trains of dump cars, pulled by dinkey engines, which carry the excavated material forward and back along the embankment. As on section No. 1, the excess sand and gravel is stored and sold. The cost of constructing this section is about 20c. per cu.yd. The cost of constructing section No. 2 will be between 20 and 25c. per cu.yd.

The cross-section of the boulevard embankment is shown at *B*, in Fig. 2. The width of the boulevard at the top is 75 ft. in nearly all cases, but in a few instances it has been made wider, in order to increase the height of the inside berm without making the increase noticeable. The width comprises a roadway 40 ft. between curbs, an inside berm of 5 ft. and an outside berm of 30 ft. The inside berm has a variable slope from 1 on 4 to 1 on 1½, while the outside berm has a slope of 1 on 1½ ft. Both berms have a slope of ¼ in. per ft. toward the roadway. The 30-ft. berm carries two rows of trees; one row being 2½ ft. from the property line and the other 6 ft. from the curb line. This berm also carries a 6-ft. walk at 5 ft. from the property line. The lawns have 2 ft. of good top soil, while the roadway consists of gravel.

At points along the creek from Capitol Ave. to Central

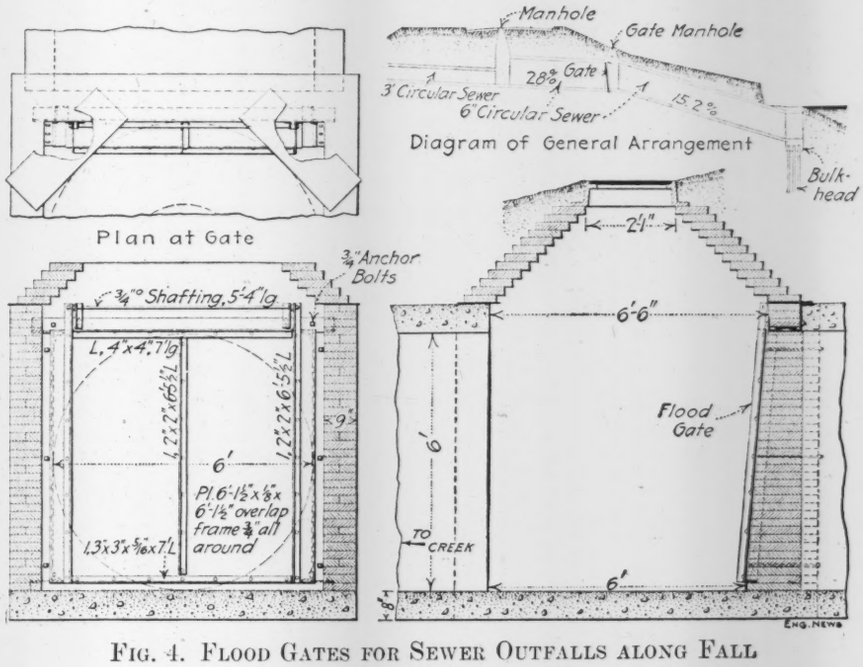



FIG. 4. FLOOD GATES FOR SEWER OUTFALLS ALONG FALL CREEK, INDIANAPOLIS, IND.

Ave., where property values are high, the boulevard is built so closely to the creek that it is necessary to have a retaining wall, not only to carry the embankment, but to give a greater section of channel. The sections of these walls are shown at the right in Fig. 3. They were built shortly after the flood of 1904.

FIG. 5. NEW LEVEE AND BOULEVARD ALONG FALL CREEK, INDIANAPOLIS (LOOKING WEST FROM NORTHWESTERN AVE. BRIDGE)

FIG. 6. BUILDING NEW LEVEE WITH STEAM SHOVEL AND DUMP-CAR TRAINS

A retaining wall between College Ave. and 30th St. was made necessary by the 1913 flood and is now under construction (Fig. 3). This wall sets well into the stream, as shown by section *C* in Fig. 2, so that peculiar conditions entered into its design. As only a portion of the backfill will be made at this time, the wall had to be designed so as to withstand a high-water level without backfill and also to carry a backfill in time of low water. Since this was to be a reinforced-concrete wall, these conditions made it necessary to reinforce the face as well as the back of the wall.

In addition to protection by walls and boulevard embankments, protection from backwater through sewers became necessary. Every sewer emptying into the creek was provided with a steel flood gate, as shown in Fig. 4. This gate was hung in a manhole constructed either at the top of the embankment or within the flood channel; otherwise the top would be raised by the water pressure and spouting would result. Of course, this makes it impossible for surface water to get away during a flood, but it is anticipated that this water will escape before the

FIG. 7. BUILDING NEW LEVEE BY DRAG SCRAPER AND SLUICING

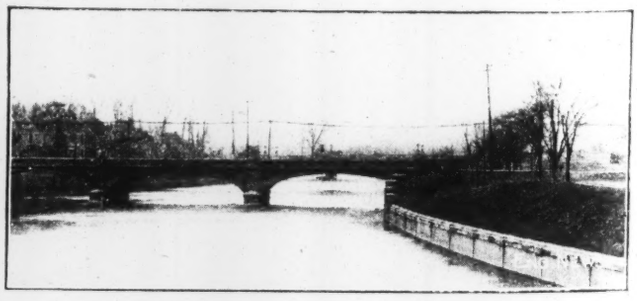


FIG. 8. RIVER WALL AND FILL OF FLOOD-PROTECTION WORK ON FALL CREEK, INDIANAPOLIS, IND. (SHOWING THE ILLINOIS ST. BRIDGE)

creek reaches the elevation at which the gates will close.

With the completion of the work now under construction, Fall Creek will be harnessed as far south as the canal (Fig. 1). It is the intention of the Board of Park Commissioners to extend the boulevards southerly on both sides of the creek as rapidly as possible.

Fig. 5 is a typical view of the new bank and boulevard. The two sides of the fill are of earth, while the roadway fill between them is of gravel several feet deep; the gravel fill may be seen in the distance, to the left of the big trees. Fig. 7 shows a drag scraper plant making the fill north from 30th St. to the Fairgrounds bridge. The scraper cable is carried across the river; the bucket works across the bed and dumps the gravel at the tower, where screens are fitted, separating the gravel from the sand. From this the sand flows through the chutes to form the fill. Fig. 6 shows the fill being made by steam shovel and dump car. Fig. 8 is a view looking west toward the Illinois St. bridge, where the river is confined between masonry walls supporting the fill.

## Aluminum Alloys as Surface Protection for Metals Subject to High Temperatures

A process has been developed by the Research Laboratory of the General Electric Co., by which aluminum alloys are formed on the surface of metal articles, particularly iron, steel and copper, and by which they are made more resistant to oxidation at temperatures above a red heat. This process has been called "calorizing." Articles may be heated in revolving drums with mixtures containing finely divided aluminum or those pieces which, because of shape or size, are not adapted for tumbling may be treated by packing them in or painting them over with the aluminum mixtures before heating. In this way the size of the heater which can be employed is the only limitation on the size of the piece that may be treated. Wire or ribbon may be treated by a continuous process, in which it is passed through a heated pipe containing the proper mixture.

The life of the coating seems to depend on the temperature at which it is used, as well as the duration of time allowed for the formation of the surface alloys. Long use at temperatures in excess of 1100° C. results in destruction. The thickness of the alloy formed varies with the length of time to which the piece is subjected to the process. The percentage of aluminum varies through the coating, being greatest at the surface. On a calorized copper rod the line between the alloy and the unchanged copper is sharp, but the color of the alloy varies from golden yellow next to the copper to silver white at the surface. Cross-sectional photo-micrographs show the large crystals of the calorized surface and the typical crystalline structure of the copper beneath. Some blistering of the copper immediately below the calorized surface is indicated by spaces between the copper crystals. If the process is conducted at a high temperature and the mixture is rich with aluminum, two layers of different alloys may result.

When an iron pipe or ribbon is calorized for a heating unit, the resistance and temperature coefficients are changed; the thicker the calorizing coat, the greater the change. The dimensions and weight of either a copper or iron piece are slightly increased by the process. The increase of dimensions is much less than the thickness of the alloy coat. There is a tendency to a greater increase at the edges than on flat surfaces.

Calorizing is not intended to compete with galvanizing, sherardizing, and similar processes for protection against corrosion at low temperatures, although for low temperatures calorizing is effective against the corrosion of copper as well.

The theory of the effect of the aluminum in the surface alloy is that a thin coat of aluminum oxide forms to prevent further attack of the metal beneath. This is similar to the protection which aluminum articles receive under some conditions.

Several recent typical examples of this protection are described in the October issue of the *General Electric Review*. Two pieces of similar iron pipe, one plain and the other calorized, were heated side by side with a laboratory blast lamp to a temperature of about 900° C. for four hours, then cooled and the heat reapplied for another period of four hours. At the end of that time the untreated pipe was badly burned, the metal being reduced at the point of the flame to one-half original thickness. The whole surface was blistered. The calorized pipe appeared to be unchanged. Previously, the calorized piece had been used in an electric resistance furnace where it was heated alternately to 1000° C. and cooled, being maintained at the maximum temperature in all for about 50 hours. The same piece was heated to about 900° C. and plunged into cold water after it had cooled to a dull red. On repeating this three times, the surface showed no signs of crack or scale.

Two pieces of sheet-iron tube, one calorized and the other plain, were subjected to a temperature of 800° C. in a gas furnace for 100 hours. The plain piece was practically destroyed, while the calorized piece was unharmed. An untreated piece of the iron wire or ribbon, such as is used in electric heating units, will burn out in four or five hours at the most, whereas the calorized strips have their life increased at least fifty times and in some cases over one hundred times. A life of 500 hours at a temperature of 800° C. may be expected from calorized heating units.

Calorized seamless iron tubing is being used for combustion tubes in the company's laboratory where pure oxygen is brought in contact with the metal at temperatures of 900 to 1000° C. These appear unchanged after 100 hours' service.

In some cases calorized copper may be used in place of aluminum bronze. In one large power station, which was having trouble from early corrosion of aluminum bronze condenser tubes, a set of calorized copper tubes were installed and in the 2½ years since not one has failed, whereas before the tubes would fail in four to six weeks. Railway controller contacts which had been calorized showed double the life of ordinary untreated parts.

**Railroad Ice Storage Houses** are the subject of a report which a committee of the American Bridge & Building Association presented at the recent annual meeting. The report is very complete, and in effect constitutes a treatise on the design and construction of such houses. Following a seven-page résumé the necessities of railway ice storage house design and the details of construction, the report contains some 60 pages of detailed description of houses which have been built by various American railroads. Copies of the report probably can be obtained from the secretary of the Society, C. A. Lichty, 319 No. Waller Ave., Chicago, Ill.

# Field and Office

## Plant and Working Methods on Approaches to North Side Point Bridge

By E. L. Jones*

The erection of two steel spans across the Allegheny River at the extreme point of land where the Allegheny and Monongahela rivers form the Ohio, and at a height of 72 ft. above pool level and 40 ft. above the sloping banks of the river, made it necessary to construct 900-ft. approaches on both sides with a grade of 5%. The approaches as well as the bridge itself are 56 ft. wide with a 36-ft. roadway and two 10-ft. sidewalks, provision being made for two car tracks on the roadway.

The south approach was designed with the idea of utilizing the present approach to the Point Bridge over the Monongahela. This idea was carried out by building reinforced-concrete retaining walls on both sides to widen the approach and raising the street to the new grade by making an earth-and-slag fill. This change in the old approach to the new grade made it necessary to raise the shore span of the old Point Bridge 2 ft. 7/8 in. The intervening gap between the intersection of the center lines of the two bridges and the new bridge was spanned by two reinforced-concrete arches with a clear span of 73 ft. 6 in. and 85 ft., respectively.

As conditions were different on the north side of the river, it was found advisable to use six reinforced-concrete arches diminishing from a clear span of 85 ft. at the river to a span of 40 ft. 4 in. at the last arch. From the abutment of this arch to the intersection of the approach with South Ave. high reinforced-concrete retaining walls were used with an earth-and-slag fill to grade.

The retaining walls were designed in three types—all, however, having spread footings to distribute load over a porous subsoil. Walls up to 15 ft. in height were of the gravity type. Those from 15 to 24 ft. in height were designed as cantilever walls, while those over 24 ft. were all built with counterforts.†

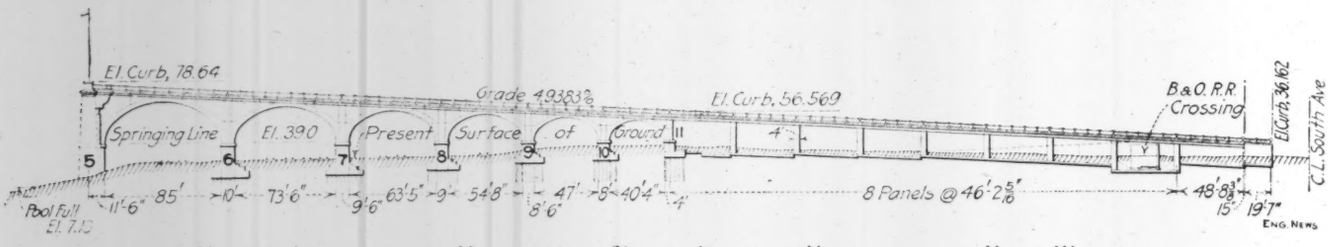
Because the ground on both sides was all filled material of a porous nature, concrete piles were driven under all arch piers with the cutoff from 8 to 15 ft. below ground level. The arches are of reinforced-concrete rings the full width of the approach, diminishing slightly in thickness under the sidewalk. Spandrel walls carry the flat roadway slab while the sidewalk rests on the side walls and roadway slab.

The steel spans over the river were erected by the American Bridge Co. in 1911-12, but, because the City of Pittsburgh had no available money, the contract for the approaches was not let until early in 1914. They are slated to be finished July 1, 1915, at an estimated cost of $375,000.

The work comprises some 15,000 cu.yd. of excavation, 17,300 cu.yd. of plain and reinforced concrete, 600 tons of structural and reinforcing steel, 13,000 cu.yd. of slag fill, 28,000 lin.ft. of concrete piles, also handrail, sewers, paving, sidewalks, etc.

### Mixing Plant

Immediately after the contract had been let, the contractor began erecting his plant and getting equipment on the ground, but there was not much that could be done until spring. As all sand and gravel used on this work was dug in the Allegheny River and delivered to the job in wagons, it was necessary to lay out the mixing plants with this in view.




North Approach to North Side Point Bridge (Elevation of East Wall)

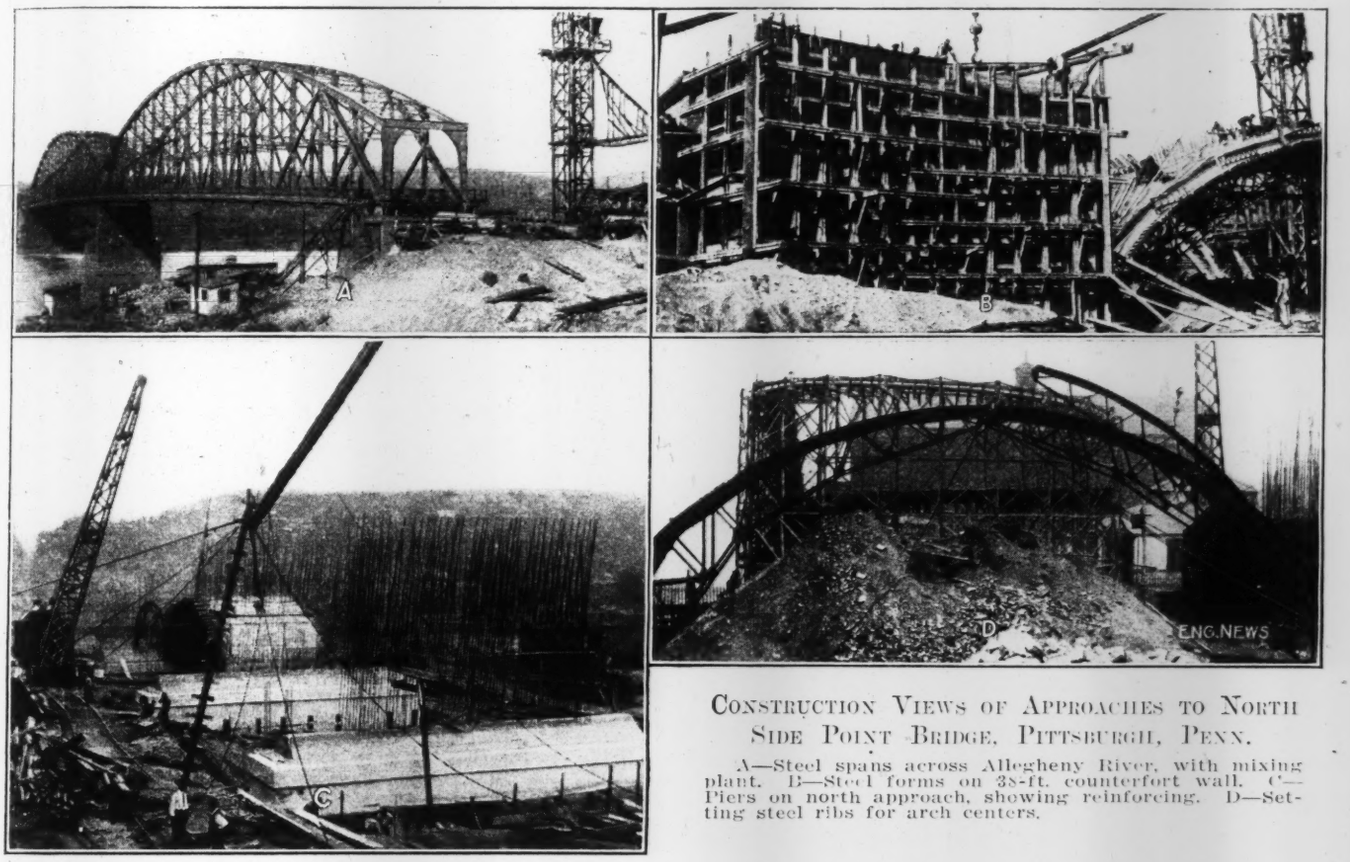
On the south approach the mixing plant was located opposite pier No. 2, in order to take advantage of the sloping ground, which ran up to the present Point Bridge approach; so by building a short trestle, level with the approach, teams were able to dump sand and gravel into the top of the 30- and 60-cu.yd. storage bins. Under the bins was a 3/4-cu.yd. Ransome steam-driven mixer with measuring hoppers attached. Concrete was dumped directly into a 40-cu.ft. hoist bucket and hoisted to the top of a 96-ft. wooden tower, from which it was distributed by one especially built concrete chute supported on a 50-ft. latticed wood boom, which also held up one end of a 50-ft. free-end chute, thus making a full radius of 100 ft. and enabling the contractor to place concrete at any point on piers and arches No. 1 and No. 2, and, by adding 100 ft. more, three sections of wall could be reached. The remainder of the walls were concreted with a 1/4-cu.yd. Ransome street mixer placed on top of the wall and moved ahead by a locomotive crane, which ran on a track parallel to the wall. The capacity of this crane was 15 tons. It had a 55-ft. boom and was used for all wall excavation and to move forms from one section to the next.

*Constructing Engineer, Booth & Flinn, Ltd., Contractors, Pittsburgh, Penn.

†These retaining walls are of the types described in an exhaustive article on "Some Important Street Improvements in Pittsburgh," "Engineering News," Sept. 26, 1912, pp. 568-576.

Excavation for pier No. 1, which was 31 ft. deep, was done with a guy derrick handling a 1-cu.yd. dump bucket. This derrick was afterward moved onto the north end of the bridge and used to assist in setting and removing steel centers. Cement was delivered in cars to within about 1,000 ft. of the plant; but from that point was hauled in wagons to the top of the bins and dumped down a wooden chute to the mixer. A storage shed for 800 bbl. was provided. With a few minor exceptions, the arrangement of the mixing plant on the north end was the same as on the south end.

All excavation on the north end was done with a ¾-cu.yd. orange-peel bucket, operated by a 30-ton locomotive crane with a 70-ft. boom. This crane was also used for setting arch centers, handling wall forms and placing concrete in the walls. The large mixing plant was located so as to chute concrete to all parts of the six arches, while the walls were taken care of by the same method as that employed on the south end.




CONSTRUCTION VIEWS OF APPROACHES TO NORTH SIDE POINT BRIDGE, PITTSBURGH, PENN.

A—Steel spans across Allegheny River, with mixing plant. B—Steel forms on 38-ft. counterfort wall. C—Piers on north approach, showing reinforcing. D—Setting steel ribs for arch centers.

## PILES

As soon as the excavation on the first pier had been carried down to the required depth, the work of driving the piles was started. The piles were placed 3 ft. c. to c. each way, over the entire bottom of the pier foundations. The large foundations were 26x57 ft. in plan, and as all the excavation was done before the piles were driven and the pier foundations were from 10 to 16 ft. in depth and in most cases sheeted and braced, it was out of the question to lower the piledriver into the hole. Therefore, 24-in. I-beams, 40 ft. long, were placed across the hole to support the piledriver. It was found that about as good progress could be made working from the I-beams as would have been obtained on the ground itself. A row of piles was also driven about 7 ft. c. to c., under the front edge of the retaining walls of the north end, but no piles were placed under the south walls.

All piles were Raymond cast-in-place concrete piles and the core was driven with a steam hammer. Seven blows to the last inch gave them sufficient penetration to withstand the test required by the city, which was that one pile in each pier be selected and loaded up to 60 tons with an allowed settlement of ⅜ in.* On account of the irregularity of the underlying gravel bottom into which the piles were driven, their length varied from 12 to 27 ft., averaging 17 ft.

## CONCRETE

Piles were first driven on the south approach, then the piledriver was moved over to the north approach; but on account of waiting to make the tests it was nearly five weeks from the time the selected pile was driven until the concrete could be placed in the piers. Concrete was placed in wood and steel forms in lifts of about 300 cu. yd. at a time, that being about the average amount of concrete placed in ten hours with a ¾-cu.yd. mixer. As fast as two adjacent piers were concreted up to the spring line the centers for the arches were set up, and at the same time work was started on the retaining-walls and carried on so that both would be completed at the same time.

The arch rings were concreted in three 18-ft. wide sec-

*In testing a pile, a circular steel plate was first grouted on the pile head, and on this was placed a latticed steel column which carried balanced on its top the loading timber on which rested the tank framework. Side posts were also provided for carrying the tank framework through the medium of wedges until a balance was attained. When the wedges were struck, the tank, containing the desired load of water, rested on the pile under test. See also article describing these tests, in "Engineering News," Aug. 6, 1914, p. 310.

tions. Concrete was first placed at the spring line and kept at the same height on both sides of the arch until it met at the crown. The flow was regulated by a damper in the chute, at the center of the arch; one batch from the mixer was allowed to flow to one side while the next one went to the other. A section containing 270 cu.yd. could be filled in from 8 to 10 hr.

In all cases the center section of the arch ring was concreted first and allowed to set from 15 to 20 days, depending on the weather, before the center was removed.

Work on the north approach was carried on in the same manner as the south end; walls and arches were worked together.

FORMS—The forms on this work were something of a problem, as only two pairs of arches out of eight were identical, and the wall forms had to be constantly changed from one type to another. After a careful study it was decided to use sectional steel forms for the wall, and steel ribs covered with 4x4 lagging for the arches. The steel wall forms were built up in place for the first section and then moved ahead by the locomotive crane in sections 15 to 20 ft. wide and the full height of the wall, which varied from 10 to 36 ft.. Some of these sections weighed about four tons, but no trouble was experienced in placing them with the crane. The only difficulty encountered was changing plates to fit around braces in the deep ditches. This sometimes required much time; but on gravity walls and walls where there was no bracing to contend with, the steel forms worked very successfully.

The arch forms were made up with four steel ribs for each 18-ft. section, spaced 5 ft. 6 in. c. to c., and bolted together with angle iron and cross braced with rods having turnbuckles for adjustment. Planks, 2x12 in. in cross-section, were bolted on each rib and to this was nailed the 4x4 Y. P. lagging which was surfaced on four sides and beveled 1/8 in. on two sides so that the top edge would fit tight. The top forms were made from 2x12 surfaced yellow pine and were wired down to the lagging.

REINFORCEMENT

Because of its varied lengths and sizes, the reinforcing steel was ordered in 40-ft. lengths and cut on the job as desired, with hand-operated cutters of German manufacture. These cutters were found superior to anything in that line on the market in the United States. The steel reinforcing for the counters in the counterfort walls was made on the ground and hoisted into place by the crane and the forms placed around it. The other steel was placed after the forms were set.

The arch steel was bolted with hookbolts to transverse lattice struts, set radial to the arch, and spaced about 9 ft. 6 in. c. to c. By this means the steel was held rigid.

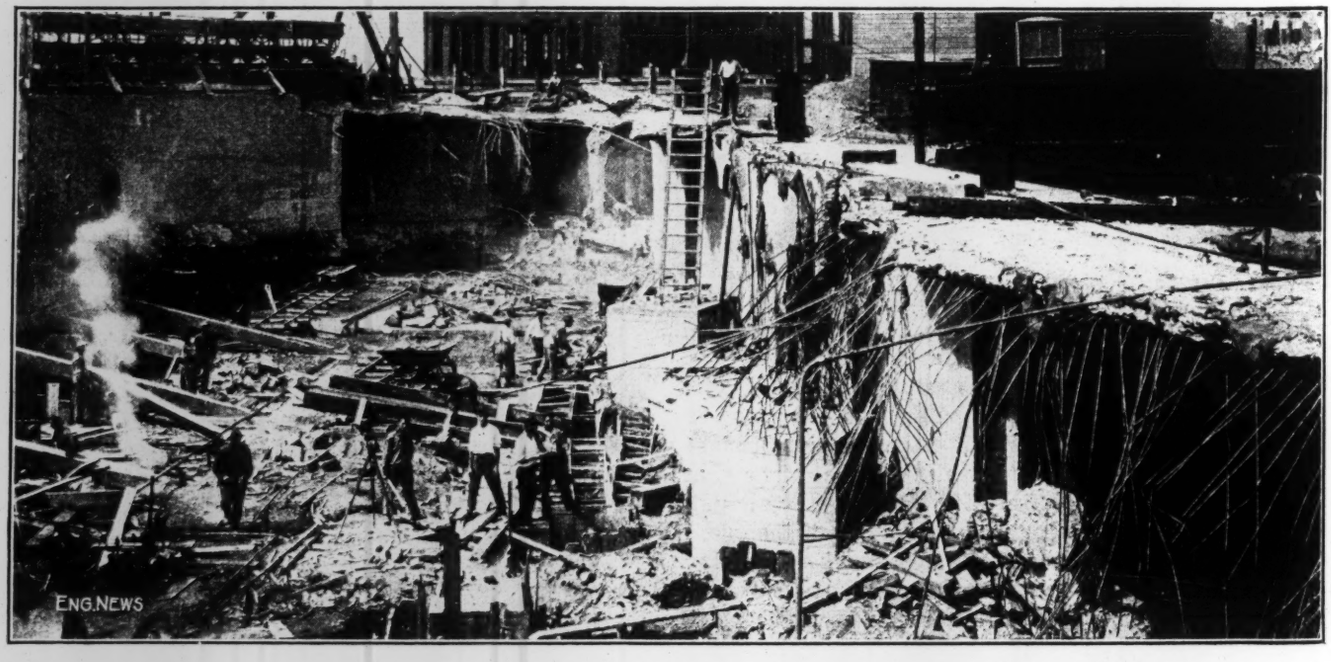
Diamond bars were used throughout the job, of the same cross-sectional area as square bars of the same weight, but much easier to handle and bend.

PERSONNEL

The work was designed under the direction of N. S. Sprague, Superintendent of the Bureau of Engineering, Pittsburgh; T. J. Wilkerson, Division Engineer of Bridges. Booth & Flinn, Ltd., Pittsburgh, are the general contractors, for whom M. J. Feeney is General Superintendent and the writer Constructing Engineer in charge of the work. The Raymond Concrete Pile Co. were subcontractors for the piles, while the Blaw Steel Construction Co. furnished the steel forms and arch centers.

## Tearing Out a Reinforced-Concrete Subway

In preparing to connect the present eastern terminal of the old Steinway tunnel under the East River at New York City with the new line of rapid-transit subways extending into the borough of Queens, it was necessary to remove approximately 800 cu.yd. of reinforced-concrete subway structure. The accompanying view, from a photograph taken within the past month, shows the work of demolition practically completed. The structure re-




EAST TERMINAL STEINWAY TUNNEL, LONG ISLAND CITY, REMOVED FOR NEW SUBWAY CONNECTION

moved consisted of a 14-in. roof slab supported on sidewalls and intermediate columns, all reinforced and tied together. The old terminal station was completed in 1907, so that the concrete had reached a final set; in fact the monolithic character of the whole structure made its destruction most difficult.

Several methods of razing were tried before a successful one was hit upon. First, holes were drilled for blasting in the center of the sidewalls, but when fired the reinforcing rods held the walls and roof as firmly as before. Next, the roof was attacked with a 2300-lb. piledriver hammer swung from a derrick; this made practically no impression. Finally, it was decided to begin at the joints of the sidewalls and floor where the rods crossed each other at right angles. These walls were 2 ft. thick at the top and reinforced with two vertical rows of 1¼-in. rods.

In the horizontal line of the joint between sidewalls and floor, holes were driven downward at an angle of 45°, spaced 18 in. apart. On firing these holes the bond at the joint was broken. The roof was similarly drilled from the outside and broken down by blasting. This plan resulted satisfactorily, and sections of the sidewall and roof were successively tumbled into the tunnel where they were broken up by drilling and firing 6-in. holes.

The piers and columns supporting the roof were blasted out by drilling holes on one side, inclined down about 45°. When fired these charges had a twisting force which cut the columns from off the piers. Two of these piers will be seen in the view, a ladder standing on one. They were originally intended to carry, in addition to the roof of the subway, a six-story office building.

The Degnon Contracting Co. has the contract for the removal of the existing station and loop, and, in addition, will construct a new station a short distance east of the old site, and an elevated structure to the plaza of the Queensboro Bridge.

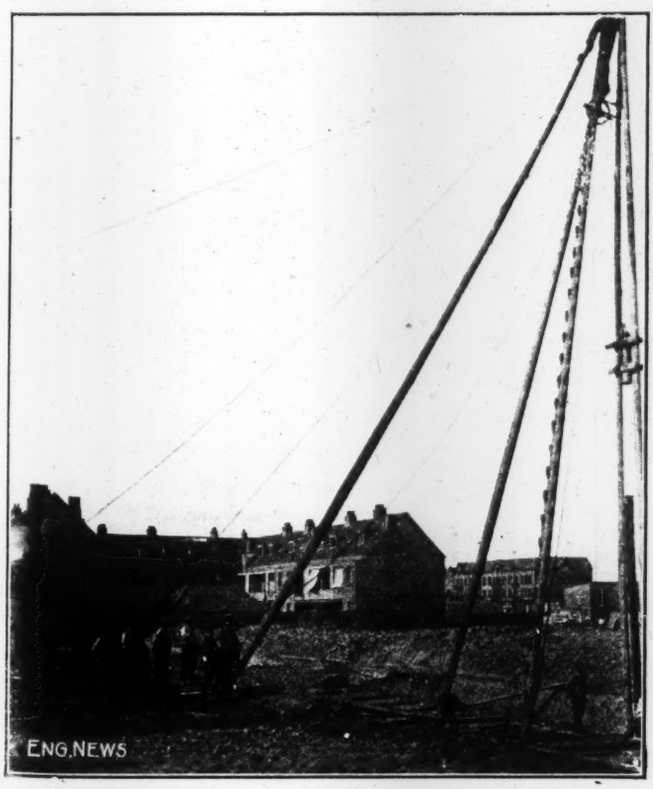



FIG. 1. GUY PILEDRIVER, AMSTERDAM, HOLLAND

## A Dutch Piledriver

The accompanying views show a piledriver of remarkable design in action in Amsterdam, Holland. In Fig. 2, note how loosely the ram hangs between the leads.

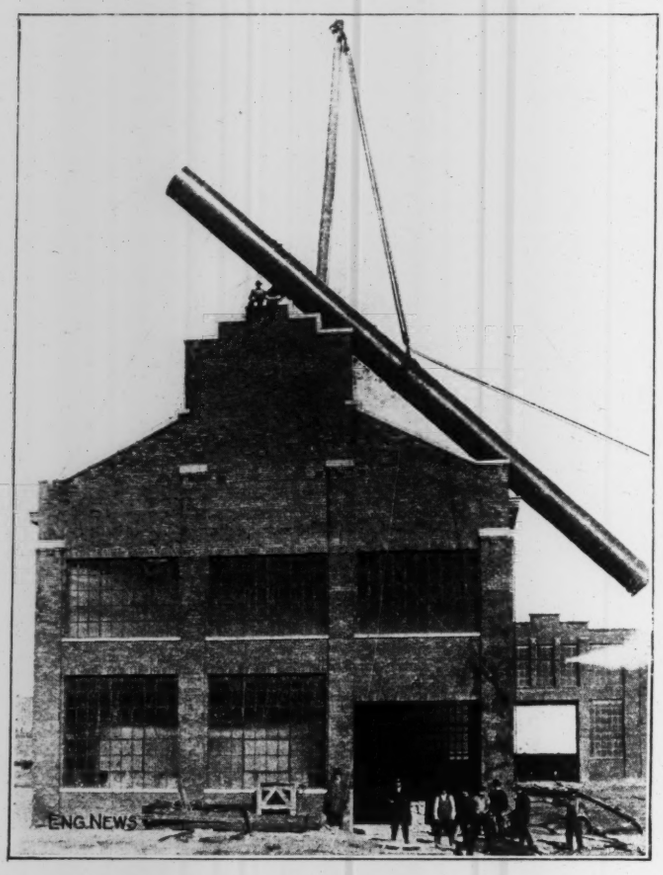
William Hoeker, of 21 Plaats, The Hague, Holland, who furnished the views, says that the Building Department of Amsterdam restricts the loading on an average wood pile (0.24 m. or 9.36 in. diameter) to about 10 tons. He says that few pile failures occur, but that occasionally long piles are driven until they penetrate the hardpan under the mud topsoil, in which case the foundation sinks.

FIG. 2. THE PILEDRIVER WORKING IN RESTRICTED QUARTERS

**Points on Waterproofing**—In answer to a query as to the preference for brick laid in asphalt mastic over membrane waterproofing on the New York subway work, F. Lavis gives the following explanation: "The brick in mastic is usually used where greater security is required than is afforded by the felt or fabric waterproofing, and where the necessity of making the best possible provision against failure warrants the additional expense. The felt has been known to disintegrate under the action of groundwater strongly impregnated with illuminating gas drip, which does not affect the mastic. Usually the brick in mastic is used below the level of M.H.W. where pressures have to be resisted and where a failure of the waterproofing might mean very serious trouble. The mastic is used hot."

## Erecting an Assembled 95-Ft. Steel Stack

A steel stack 95 ft. long, 36 in. in diameter and weighing 4 tons, was found to be too long to be set up from inside the building, so it had to be hoisted from the outside, as shown in the accompanying view. This difficult task was further complicated by the presence of a tile roof, which had to be protected.




A Cleveland Stack-Hoisting Job

On the top of the boiler, which was 15 ft. above the ground, was a 10-ft. breeching, so that the top of the stack was 120 ft. above the ground.

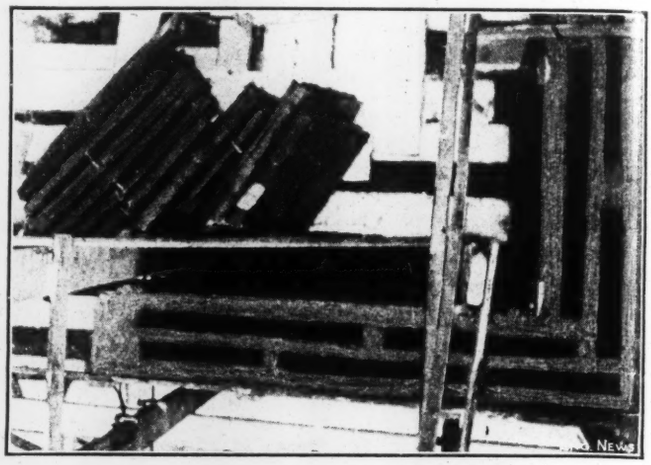
The stack was recently set at the Parish & Bingham power plant, Cleveland, Ohio, by the O'Brien Hoisting & Contracting Co., of that city.

## Collapsible Inner Forms for Hollow Concrete Walls

A new system of hollow concrete wall building whose unusual features are the use of collapsible inner forms and the staggering of the concrete cross-webs is about to be placed upon the American market. In setting, two tiers of the outer forms are clamped to braced posts along the entire face of the wall, and one tier of the inner forms is placed.

A day's work consists of placing, greasing and filling with concrete a 2-ft. high section of forms. The next morning the inner forms are lifted vertically and reset on a pair of stirrups laid across the day-old concrete. Collapsing the inner forms is accomplished by turning a handle provided for lifting the forms as well. Another tier of outer forms is then placed. Plastering and stucco work can follow directly behind the concreting. The illustration shows a partly constructed wall, seen from above.

In the normal walls built under this system, the inner forms are about 3 in. thick; the thickness of the cross-




Hollow Walls Built with "Effectiv" Forms, Seen from Above, Showing Staggered Cross-Webs

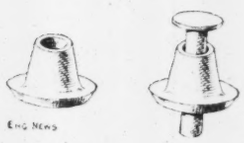
web is 3 in.; the total thickness of wall is 12 in. Only the outside slab is free from direct loading.

The Effectiv Building Co., which handles this system of hollow concrete wall building in this country through its representative, S. T. Dahl, 220 West 57th St., New York City, claims that buildings have been erected by this method in Sweden at a cost comparing favorably with that of frame construction.

## NOTES

**Driving a Ring of Sheeting for a Shaft** was done in a special way in some recent work at Milwaukee. The shaft is about 45 ft. deep through soft ground, and to excavate it successfully it was necessary that the shaft walls should be reasonably tight. Steel sheet piles of full length (45 ft.) were assembled standing on the ground to form the circle of the shaft 11 ft. in diameter, the interlocks being made as they were placed. When the full ring was thus assembled, the piles were driven in a simultaneous step-by-step operation, each pile being driven a foot or two, and then the next, and so on around the ring before returning to the first pile and driving it farther. The driving was done with a steam hammer swung from the boom of a derrick car, which was used to set up the piles in the ring.

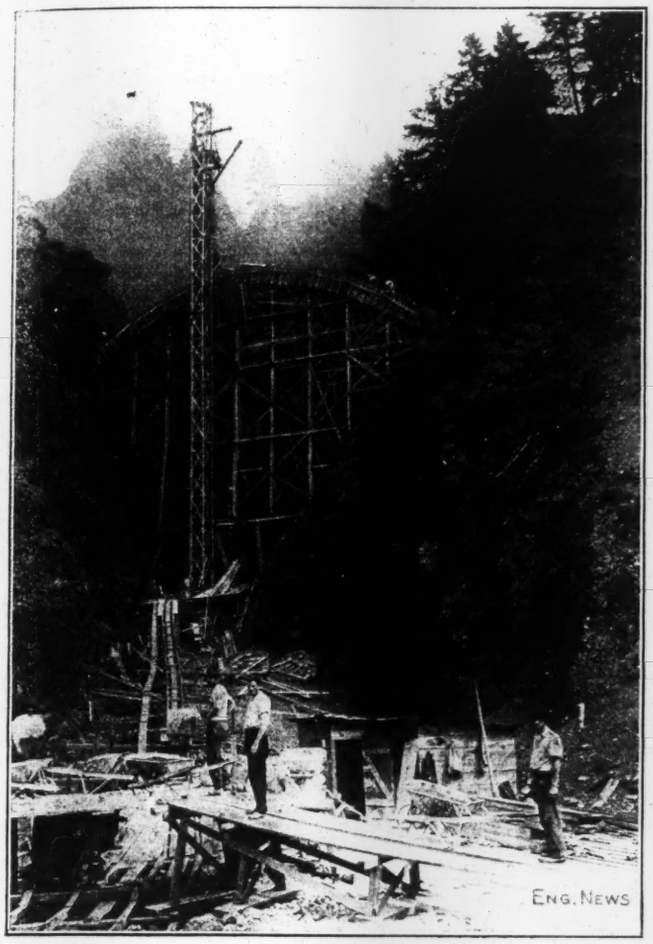
This work was part of the operations in building a conduit for pipes and cables under the Milwaukee River for the Milwaukee Electric Ry. & Light Co. at Oneida St.




**A Nail Collar to Facilitate Pulling**—In all temporary work, such as scaffolding, concrete form work, etc., money will be saved if steps are taken to make it easy to pull the nail. The accompanying cut shows a small steel collar which is fitted over ordinary wire nails, and which holds the head of the nail out from the surface of the wood, so that it can be engaged with the claw of a hammer and so pulled easily. This "pull-easy" collar is made in three sizes. On concrete form work it has been especially useful. It is manufactured and sold by the Wagner-Behm Co., Chicago, Ill.

**An Ideal Location for Gravity Deposition** of concrete is shown in the accompanying view of the construction of the Shepherds Dell bridge recently completed on the Columbia Highway, which is being built by the State Highway Department of Oregon. The highway passes through mountainous country which requires a number of bridges of different types. The bridge shown in the view is across a narrow gorge at

the bottom of which (and in the foreground of the view) runs a railroad on which the concrete material can be brought in. The material is stored alongside the track, mixed there and brought on the runway in the foreground and wheeled

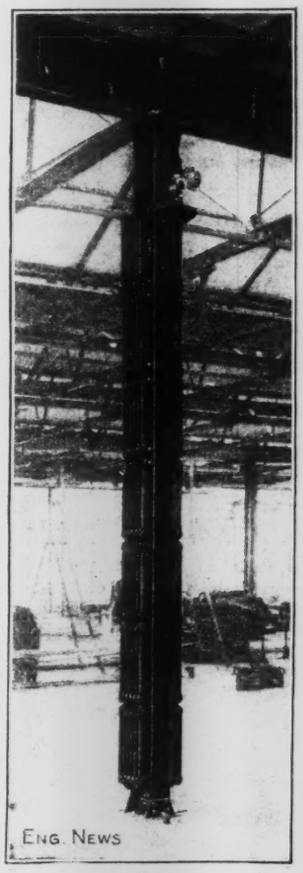



POURING CONCRETE IN ARCH RIBS OF SHEPHERDS DELL BRIDGE, OREGON

in barrows over the runway, to be dumped into the cars which run directly under the platform on the left. These cars are then pulled by cables up the inclined track to the base of the tower, elevated to the top and spouted through the chutes to the proper location on the bridge. The contractor for the bridge is the Pacific Bridge Co., and the engineering is in charge of the State Highway Department.

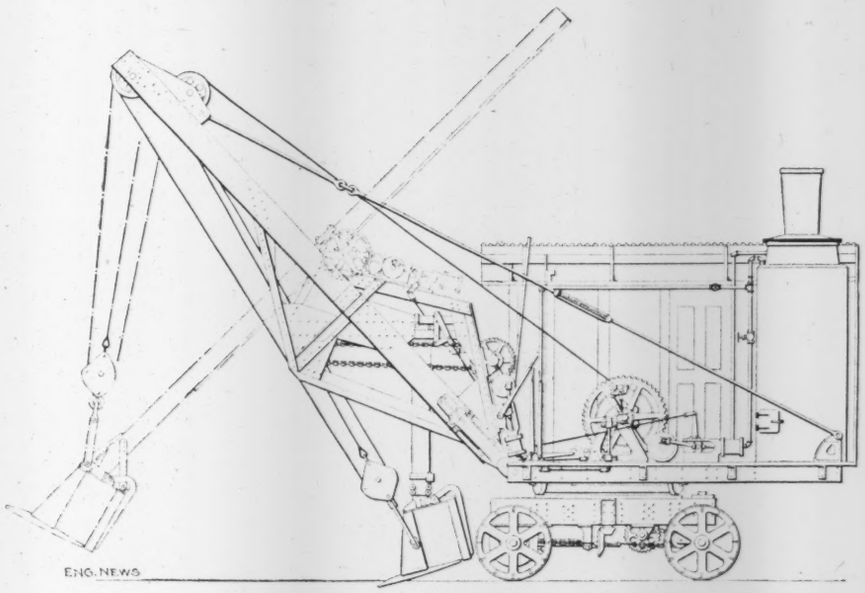
**A Combination Boom for Steam Shovels**—A boom has been designed by the Thew Automatic Shovel Co., of Lorain, Ohio, with which the shipper-shaft motion commonly used on steam shovels can be used, as well as the horizontal crowding motion employed on this concern's machines for many years. The latter is well adapted for shallow cuts and surface work; the former for trenches and where long dumping radius or high clearance lift is needed. The two mechanisms are independent and noninterfering. With the long-handled dipper in use, the short dipper arm is chained to the boom; when the short-handled dipper is wanted the long arm is removed. Change of engine, steam connections and dipper handles takes about three hours. The long handle is of wood, 8x8 in., plate armored and fitted with racks on the under side. Any length up to 24 ft. can be used, although where a clearance lift of over 10 ft. is required, a part of the cab roof must be removed. The striking peculiarity of the combination boom is the diamond frame necessary to accommodate the engine in two positions.

**Getting Radiators Out of the Way**—At the plant recently completed for the Hendee Manufacturing Co., Springfield, Mass., the placing of the radiators offered quite a problem. No wall space was available, and it was finally decided to put the radiators on the interior columns. These are built-up I-columns, as shown in the accompanying illustration. A standard wall radiator, manufactured by the H. B. Smith Co., of Westfield, Mass., was used. These are in seven sections, five pipes per section. The radiators were held in place at the bottom by a heavy bracket. The pipe connections were made at the bottom of the stack of radiators.




RADIATORS INSTALLED ON I-COLUMNS IN A SPRINGFIELD SHOP

**New York Experience With Winter Surveys for Highway Improvement**—In the past many surveys of roads have been made in the winter when the ground was covered with snow and it was difficult or impossible to judge with any approach to accuracy of the soil conditions below. Obviously, too, surveys made under such conditions would be inaccurate. We are now trying to make our surveys in summer and fall in order that these sources of errors and troubles may be avoided. One of the most frequent excuses given for the making of supplemental agreements has been that these surveys were made in the winter when subsoil conditions could not be observed and especially drainage problems anticipated. With surveys made when the ground is bare and when the soil and drainage may be freely and carefully studied, we expect to secure more perfect plans that may be carried out and roads built with much fewer changes in contracts. More attention is being given to the preparation of these plans in detail and greater care is exercised in supervising plans presented by division engineers to headquarters to the end that they may be complete and specific, more quickly read and less liable to misunderstanding.—Geo. A. Ricker, First Deputy State Highway Commissioner, New York, in "New York Highway News" for September, 1914.




NEW THEW SHOVEL BOOM

**Inexpensive Printed Specifications of Pocket Size**—It not infrequently happens that there is need for a considerable number of copies of the contract and specifications for a piece of work while it is desired to keep the cost of such forms to the lowest reasonable point. Probably the simplest way to produce them is to have them typed on thin paper backed with carbon paper so as to give a very black impression, blueprint them on large sheets, trim them out and bind them together with eyelets. As many copies as may be required can be made in this way, but they have some disadvantages. As only one side of the paper is used, a thick volume is obtained, the printing is white on blue paper, not convenient to make notes or corrections on, and the method of binding the sheets together makes it almost impossible to lay the book down open and have it stay open at the desired page. Printed specifications of the 8x10-in. size so generally used are rather expensive to get out and it is therefore of interest to engineers to know that a considerable saving can be made if the composition is done by a linotype machine, using the 2⅛-in. measure common for newspapers, and the specifications printed in the form of a book with pages about 4x6 in. If stiff paper covers are used with a 1-in. strip of linen pasted on the back to strengthen them, and the book trimmed flush, the resulting pamphlet is easy to read, it can be carried in the pocket without folding and the pages afford margins of width enough for any ordinary notes or corrections.—Edward C. Sherman, Boston, Mass.

**Street Crossing Traffic Signals, Cleveland, Ohio**—A street traffic control system was installed last August at the intersection of Euclid Ave. and East 105th St., Cleveland, Ohio, which has given excellent service ever since. The system is operated practically the same as a railway crossing, although there are modifications in the apparatus itself to suit street conditions. It is estimated that traffic can be handled 20% faster than by a traffic policeman in the street.

Electric signal lights are placed on the right-hand side of each street, facing oncoming vehicles. A red light signifies stop, and green proceed. The switch controlling the lights is operated by a traffic officer in the booth to the left, in the accompanying illustration. The switch is so interlocked that it is impossible to give conflicting signals. The sides of the booth are glass, so that the officer may see out on all sides. The red light signal is shown on the near corner of the crossing street and the green light on the far corner, instead of having both lights on the same pole as in railway practice.

A fire-alarm signaling instrument, connected to the fire department headquarters, is installed in the officer's booth so that he is informed when it is necessary to clear the crossing for the passage of fire apparatus. On these occasions the officer closes an emergency control switch, which sounds an alarm bell and shows red lights on all signals. He is then free to leave his booth and give his attention to the street. Similar systems using semaphore signals have been tried in other cities, notably in Philadelphia.

The Cleveland installation was made by the American Traffic Signal Co., of Cleveland.

**The Crown of Bituminous Macadam Roads** in Massachusetts has been reduced to ¼ in. to 1 ft. in accordance with English practice, which is now almost universally ⅛ in. to 1 yd. or ⅛ in. to 1 ft. This is a reduction in crown of ⅛ to ¼ in. from the standard sections for bituminous macadam roads referred to in the article on Massachusetts highway work in "Engineering News" of Nov. 26, and is a minimum for highways in this country. It compares with crowns of ¾ in. per ft. width for ordinary macadam.

LOOKING EAST ON EUCLID AVE. AT THE 105TH ST. INTERSECTION (TRAFFIC SIGNALS MARKED ON PHOTOGRAPH)

# Editorials

## A Constructive Policy for Public-Service Corporations

Among the notable papers presented at the recent conference of Mayors in Philadelphia was one by Charles Day, of the engineering firm of Day & Zimmerman, with the suggestive title printed above.

Mr. Day urges that the companies should drop their attitude of antagonism toward the regulating commissions, should frankly recognize that public regulation is here to stay and should heartily coöperate with the public service commissions and city authorities. Mr. Day speaks with full appreciation of the companies' point of view, since his firm controls a large central-station plant in Pennsylvania.

At the present time the attitude of most public-service corporations and their officers toward some of the restrictive measures of the public-service commissions may be fairly described as one of rebellious protest. There is without doubt ample ground on which to base this protest; but Mr. Day declares that instead of hoping for a better state of affairs through the amendment of faulty laws or through a better appreciation of their duties and of the rights of the companies on the part of public-service commissioners, the responsibility rests squarely upon the corporations themselves. Until they come forward to coöperate with the commissions, by furnishing them the basic data on which to ascertain cost of service, bitter contention over rates is bound to continue.

The companies distributing electric current, for example, have almost universally adopted a sliding scale of rates giving a far lower rate to the large users of current, and particularly to the user who takes current at a time when a large part of the station equipment would otherwise be idle, than to the ordinary customer. Mr. Day urges that the small consumers of electric current should likewise have rates adjusted to their needs. Analysis of the operating cost of electric systems shows that a very large part of this cost varies very little with increase in current consumption.

Here, for example, is a small consumer using 10 kw.-hr. of electricity per month from which the station must receive a revenue of $1.20 to cover the fair cost of supplying the current with a reasonable margin of profit. If the consumer pays a flat rate per kilowatt-hour, the straight charge would be 12c. per kw. Analysis of the station-operating cost, however, would very likely show that two-thirds of this amount, or about 8¼c., would represent the expense incurred in such charges as bookkeeping, reading meters, rendering bills, fixed charges on equipment, distribution, etc., which do not vary with increase in consumption. If, therefore, the consumer were required to pay a fixed charge of 8¼c. per month whether he used much current or little, and in addition a charge of 3c. per kw.-hr. for current used, the company would receive the same revenue as before, $1.20, but the consumer would have every incentive to increase his use of current; for example, by the use of appliances for electric heating, which now very generally involves prohibitory expense.

Such an adjustment of rates to small consumers, moreover, would go a great way toward producing a better feeling of the public toward the companies. At present it is very difficult to make the average consumer believe that a company is justified in charging him 10c. for current which it cost the company often less than half a cent to produce at the power station.

## The New York Alien Labor Law and the Subway Contracts

Probably neither the contractors, the labor leaders nor the Public Service Commission know what is to be the outcome of the controversy over the enforcement of the Alien Labor Law on the New York subway contracts. It is fairly certain, however, that none of these three parties really desires to tie up indefinitely these contracts on which so many thousand men are now actively at work.

The Alien Labor Law makes it mandatory upon the Commission to annul any contract on which it is shown that the contractor has employed alien labor. The labor union which has petitioned for such an annulment of one of the contracts withdrew its complaint on Nov. 28, and it is claimed that this relieves the Commission of the necessity of deciding the case. According to the strict letter of the law, it might indeed be said that it is incumbent upon the Commission to annul any contract on which alien labor is employed as soon as the fact of such employment is established.

It is equally incumbent upon the Commission, however, to observe the spirit of the law and protect the great public interests committed to its care. To cancel the existing subway contracts at the present time would mean a loss of many millions to the city in the delay involved and in the difficulty and complications attendant upon the adjustment with the contractors and the reletting of the work.

Engineers well know the serious difficulties encountered when, through the failure of a contractor when his work is partially completed, the reletting of the work or its continuance by force account becomes necessary. There is trouble enough for engineers and all parties concerned when one or two of the contractors on a great engineering work fail in their task and readjustment is necessary. But the labor thrown upon the engineering force in case a wholesale annulment of existing contracts were attempted would be enough to break down the whole organization.

It is claimed that the Alien Labor Law might be declared unconstitutional as being contrary to existing treaties between the United States and foreign countries in which the citizens of those countries are promised equal rights and protection with American citizens. Certainly, the matter should be settled one way or the other by an appeal to the highest court. It is a serious mistake and

an injury to all parties concerned to have such an act as the New York Alien Labor Law remain on the statute books and be ignored. There is always a chance that such laws, after long remaining a dead letter, may suddenly be brought forward to make serious trouble for some man who has merely followed the general custom in his line of business.

## A Favorable Time for Construction Work

The amazingly low prices which are being quoted on structural steel at the present time are worthy of notice, especially since there is some reason to believe that prices in this field are about at the bottom and that a considerable advance may be looked for at no distant day. Contracts have recently been awarded by the Panama Canal to the United States Steel Products Co. for about 9,000,000 lb. of structural steel required in the construction of the wharves at the Cristobal coaling plant. The price for the material delivered at Colon is 1.967c. per pound.

When it is considered that this material has to be fabricated at the shops, carried by rail 400 miles to tidewater, loaded on board a steamship and transported 2000 miles to the Isthmus of Panama, with the cost of marine insurance added to that of freight; and further that the material is subjected to an extremely rigid government inspection, it is evident that the structural-steel business at present is being carried on with an extremely narrow margin of profit.

It is, of course, true also that other engineering materials are being sold at phenomenally low prices. The Metropolitan Water and Sewerage Commission, of Massachusetts, recently purchased 4000 tons of cast-iron pipe at $19.60 per ton, delivered at Boston.

Such prices as these make it a most advantageous time to undertake new construction work, wherever such work can be successfully financed.

Not only are prices of all construction materials extremely low, but on contract work competition is very sharp. Contracts were recently advertised in ENGINEERING NEWS for the construction of a system of water supply and sewerage for a village of 3000 inhabitants in the Hudson valley. In ordinary times such a small contract attracts only a limited number of bidders, mostly residents of the locality. In this letting, however, 42 contractors submitted bids for the construction of the waterworks, at prices ranging from $51,500 to $98,800. These bidders came from six different states. For the construction of the sewerage system there were 37 different bidders, their prices ranging from $67,300 to $102,000. These bidders also covered a similarly wide geographical range.

The labor market is extremely favorable to construction, whether work is done by contract or by day's work. Even where the unions maintain a fixed rate of wages, it is possible to choose picked men to carry on work and thus secure rapid execution and a good quality of workmanship that are difficult to obtain in ordinary times.

An additional reason for prosecuting public works at the present time is to aid, in some degree at least, to solve the serious matter of unemployment. In some way or other the men who are out of work have to be fed and clothed, and their families must be taken care of; at public expense, if they are unable to do it for themselves. It is certainly better to give a man money in the shape of wages, so that the public gets a return for the money in work performed, than to dole out a third, possibly, of that amount in the form of poor relief, from which the public gets no return whatever and the recipient of the relief is pauperized.

At Pittsburgh, the City Council on Nov. 23 appropriated $80,000 to proceed with extensive street improvements in order to furnish work for some of the unemployed in that city.

## The Maximum Rate of Safe Retardation for Passenger Cars and Elevators

Collapsible, shock-absorbing vestibules as a means of safeguarding the lives of passengers in steel cars in the event of a train collision are discussed in the report of the Committee on Rails and Equipment, presented at the recent meeting of the National Association of State Railway Commissions. It is obvious that such an arrangement would be of comparatively small benefit to the passengers in cars at the end where the collision occurred, while at the opposite end of a long train the gradual stoppage, due to the collapsing under resistance of the vestibules between the ends of the cars, would doubtless cause the stop to be very easy.

The committee deemed it best to inquire what was the maximum safe rate of retardation which passengers could endure without danger of serious injury. Inquiries were made of Thomas E. Brown, Consulting Engineer of the Otis Elevator Co., and the following reply from Mr. Brown gives very interesting data as to the possible retardation which human beings can endure in falling elevators.

Our experiments and experience have been entirely with passengers traveling vertically and standing on their feet, where the effects of retardation have been along the axis of the body, the stress being principally on the ankles and spine. Under these conditions, I and some of my associates have been subjected to retardations as high as 72 ft. per sec. per sec. Such a retardation can be sustained without injury, and, in fact, without much discomfort. The stress on the ankles is quite noticeable.

A man lying flat on the floor of an elevator car could, without doubt, withstand at least double this retardation without serious inconvenience.

In air-cushion practice it is customary to allow for retardations of five or even six times that of gravity, i.e., retardations up to nearly 200 ft. per sec. per sec., and it is considered that even this high retardation will not be injurious to life. Naturally, but few actual tests with human beings at such high retardations have been made, but there are several instances on record where it has been sustained without any serious injury. Unfortunately, there have been cases in such tests where serious injuries and even death have resulted, but there is reason to believe that in these cases, through faulty design, the retardations were considerably in excess of five or six times that of gravity.

Naturally, the physical condition and especially the position of the subject when undergoing such a shock must be taken into consideration; thus a man in a sleeping berth with feet toward the engine would not be likely to be killed and perhaps not even injured by a retardation of 150 to 200 ft. per sec. per sec., whereas it is doubtful whether a man riding headforemost under the same conditions might not receive a broken neck.

My own opinion is, that if the railroad car remains on the roadbed and is sufficiently strong not to be destroyed or splintered by the shock, the passengers, with the exception of such as may be in an unfortunate position, are not liable to sustain other than minor injuries with any stop liable to occur in a derailment or even a collision. In other words, assuming the conditions expressed in your letter, viz.: "Disregarding all dangers from passengers coming into contact

with the car," I am of the opinion that the passengers can stand any retardation that the car itself can stand.

In this connection I would suggest careful consideration of the fastening of the seats to the floor of passenger cars.

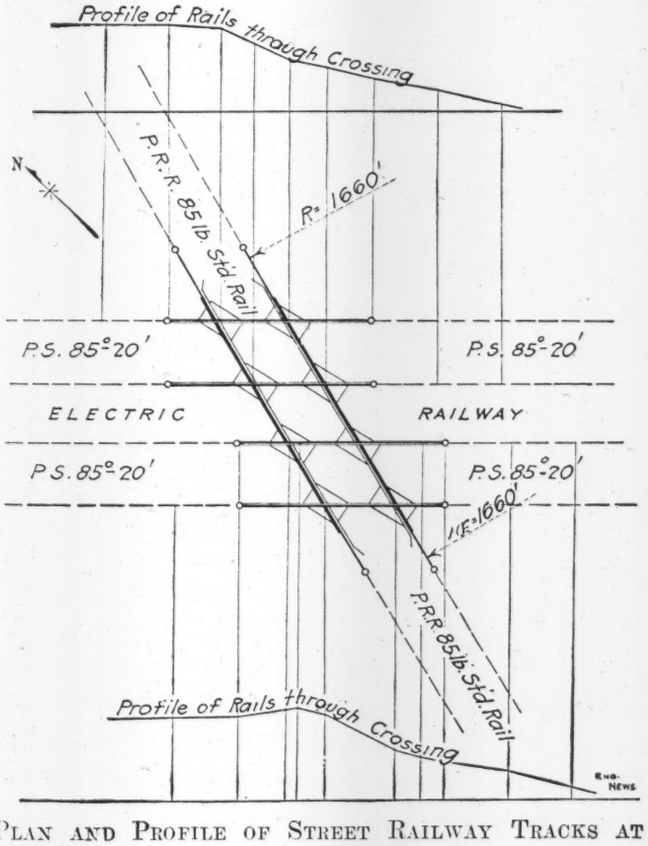
It will be evident, of course, that the retardations mentioned by Mr. Brown are many times what would be practicable in stopping railway cars by the use of brakes applied to the wheels. The limit of retardation of a car by the use of brakes occurs when the wheels slide on the rail. If a body moving at uniform speed is acted upon by a retarding force equal to its own weight, the rate of retardation would be equal to the rate of acceleration due to the action of gravity upon the body, or 32.2 ft. per sec. per sec. If we assume a coefficient of friction of the wheel on the rail before sliding occurs of one-fourth, then the maximum rate of retardation of a car by brakes would be one-fourth of the retarding effect due to gravity alone, or 8 ft. per sec. per sec. In practice it has been found that about half this, or 4 ft. per sec. per sec. is about the maximum rate of retardation by brakes that is permissible without causing discomfort to seated passengers.

The figures given by Mr. Brown for the rate of retardation which passengers in a vertical elevator can endure without danger when it is stopped by a safety clutch or air cushion seem surprisingly high. A rate of retardation of 32.2 ft. per sec. per sec. would have the effect while the retardation lasts of substantially doubling the weight supported by the person's feet and ankles and—what is less serious—that supported by the knees. With a retardation of 72 ft. per sec. per sec., therefore, the feet and ankles of a person weighing 200 lb. would have to support a weight of nearly 650 lb. for the brief period during which the retardation acts.

# Letters to the Editor

## Track Crossing on Curve with Superelevation

Sir—In your issue of Oct. 29, 1914, p. 870, appears a description of a special problem in electric-railway crossing over tracks of a steam road at grade. The writer has in mind a location where this condition exists; where street-railway tracks cross those of the Pennsylvania R.R. as shown on the accompanying drawing. The tracks on the steam road are on a curve having a radius of approximately 1660 ft. to the inside rail, while those of the street railway are built on a tangent. However, the grade of the street falls away sharply on one side of the steam road. The two profiles show how the rails of the street-railway tracks had to be kinked in order to make the crossing. The gage of the street railway is 5 ft., while the steam road is standard gage.




PLAN AND PROFILE OF STREET RAILWAY TRACKS AT GRADE CROSSING OF STEAM RAILWAY ON CURVE

The crossing is of the three-rail type and was built in 1912 by the Pennsylvania Steel Co. It is constructed of Pennsylvania R.R. standard 100-lb. rails, the main steam running and bearing rails being of rolled manard-manganese steel. The other rails are of openhearth steel. All intersections are provided with plates fastened to the rails with wrought-iron clips. The fillers are of rolled steel, and the crossing was provided with cast-steel compromise joints at all the external joints.

The connecting rail sections are as shown on the plan. Mayari steel, heat-treated bolts, having an ultimate strength of not less than 105,000 lb., and an elastic limit of not less than 80,000 lb. per sq.in., were used in the crossing, and they were required to bend cold on themselves through 180° without fracture on the outside of the bent portion. This crossing is still in service.

H. G.

Newark, N. J., Nov. 14, 1914.

## Practicing Engineers and Industrial Education

Sir—Your readers ought to realize better that engineers employed in all kinds of manufacturing establishments have an unusual opportunity for coöperating and even leading in the various forms of industrial education now coming forward. For instance, in the high school of Passaic, N. J., is an industrial course organized on a half-time basis, somewhat after the Fitchburg plan. The efficiency engineer and the textile engineer from one of the largest textile mills are giving valuable aid in developing the work. These engineers give lectures in the coöperative course on factory costs and upkeep, factory layouts,

and other broad technical topics with special applications to cotton mills. They also give instruction to the boys in the technical phases of the work. Foremen of the various mill departments give the instructions in practical operations. By this coöperation with the regular instructors of the school, a thoroughly practical course is guaranteed. Waste of time is avoided. The interests of the boys in the technical aspects of the work are stimulated and economically directed. School work and factory work are not divorced.

In developing coöperative school plans for part-time apprentices, there is a great need for men who actually know both the needs of the factory and the possibilities of the school. School men, even including many of those responsible for industrial schools or courses, know very little about actual factory needs in most cases. They have neither the knowledge nor the experience to make school courses which will supplement the factory work and give the boys what they most need. On the other hand, factory managers, superintendents, and foremen are recruited largely from the ranks of workers, promoted on merit shown for definite lines of work. Many of them know little of school possibilities. Many are even distrustful and skeptical of schools because they know that the schools of the past have been too academic and impractical.

The engineer, however, knows enough of both school and factory to show how they may help each other. He is a practical man and he has had school experience extending through elementary, high, and college grades. In looking back over his school life, he probably sees how much of the work that he was required to do in elementary and high school was really time wasted. He could devise work now on the basis of his factory experience that would have been altogether more worth while than that which he forgot as promptly as he learned it because he never has had any use for it.

The engineer realizes how relatively little of algebra, geometry and trigonometry the ordinary shop man uses, how little of the long, academic courses usually given in mechanical drawing are needed, and how needlessly foreign are the abstract statements and formulas of physics and mechanics to the common problems of the workman in foundry, forge room or machine shop. He knows that, in a factory employing a thousand men, the number whose work includes the responsibilities requiring all of this technical knowledge will probably not be over a dozen. What he recognizes is that all of these workers need a little practical knowledge of a few relatively simple parts from all of these fields. They need to know thoroughly, and with a full understanding of their meaning, a few facts and principles in shop mathematics. They should know how to make, and much more, how to read drawings and prints. They should be able to apply a few of the everyday principles of physics and mechanics in their use of tools and machines. All of this knowledge might roughly be called mechanical and industrial intelligence. The workman should not only be able to do his work with manipulative skill, but with an understanding of the meaning and reason of it.

Now the usual school man with his courses in mathematics, drawing and science will not be able to give this kind of intelligence without a prodigious waste of time. He does not know what to emphasize or what to omit. The shop itself cannot give this intelligence. The only hope for the apprentice under the present complexity of factory work is a school plan of some kind in which the school work and the shop work will interrelate at every point. The shop work must give the reason for the school work, the school work must make the shop work meaningful and intelligent. Both going along together will make for an efficiency in the apprentice and a progress in his work which will be compensation equally to him and his employer far beyond the loss of working time given to school purposes.

The engineer has the point of vantage from which to give a great deal of much-needed advice and direction to this coöperative work. He can help to organize and direct the work in mathematics and drawing which will fit in with shop needs. He can point out the parts of physics, mechanics and chemistry which will give the boy that information and that grasp of those principles which will make him an intelligent workman rather than a mere part of the factory's automatic machinery. For the practicing engineer in many manufacturing plants, there is thus opportunity for giving substantial and needed aid in building up a more efficient form of common-school education which is necessary to dissipate the frequent charges that our school system is not designed for those multitudes whom we compel to support it. The writer hopes that this statement of the opportunity will lead more engineers to lend their aid.

FREDERICK G. BONSER,
Director Industrial Arts, Teachers College, Columbia University.

New York, Oct. 24, 1914.

## The Herschel Fall Increaser and the Ejector Flow Increaser

Sir—On p. 961 (Nov. 12, 1914) of ENGINEERING NEWS, someone describing the power house built next the U. S. dam between St. Paul and Minneapolis, says it is fitted with "fall increasers (Herschel style)."

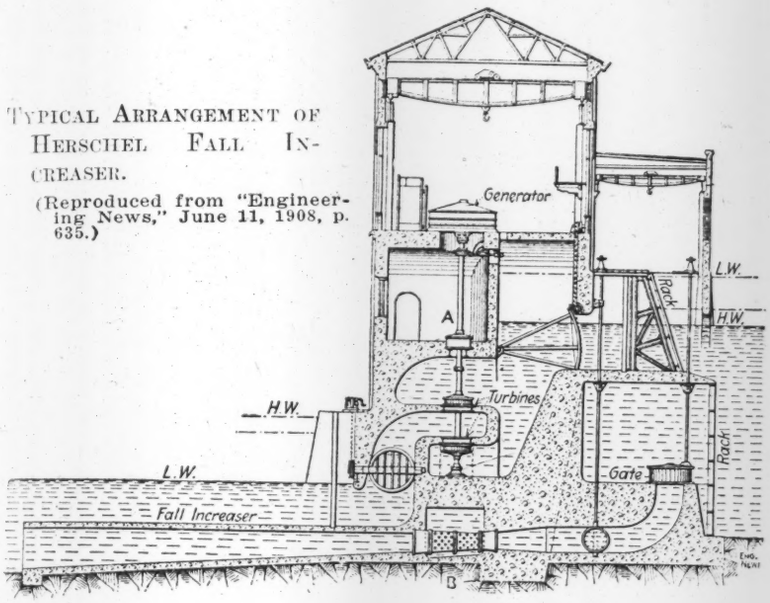
This is a hard indictment for the invention made by me, which I named the fall increaser, and hard on my interests in it, after spending thousands of dollars to test it at the Holyoke testing flume. The thing shown as having been built on the Mississippi is worthless as a fall increaser, as I can show by experiments made with it elsewhere; while the fall increaser properly so called would generate power at a power house situated as shown in the drawings referred to, and having "back-water" say 30 or more days in the year, at a cost so low that it would not pay to burn fuel to generate the same power in the auxiliary heat-engine plant needed to bridge over the *low-water* period of the year.

It is adding insult to injury to call this sluiceway built on the Mississippi by my name, not only to me but also to the true fall increaser; for everybody can see how the inevitable failure of the inefficient fake fall increaser is liable to smirch the reputation of the fall increaser that rightly bears that name.

I am sorry to add that this is the third time since the invention of the fall increaser that this same thing has occurred; at Warren, Ohio; at Eldora, Iowa; and now on the Mississippi.

CLEMENS HERSCHEL.
2 Wall St., New York, Nov. 14, 1914.

The above letter was submitted for comment to Gardner S. Williams, consulting engineer on the power plant of Lock and Dam No. 1 project near Minneapolis. In his comment, which follows, Mr. Williams refers to the auxiliary sluice which opens into the draft tube as an *ejector flow increaser.* The use of the words *fall increaser* and *Herschel style* in the original article is to be charged to the editor.]




TYPICAL ARRANGEMENT OF HERSCHEL FALL INCREASER.

(Reproduced from "Engineering News," June 11, 1908, p. 635.)

Sir—Copy of Mr. Herschel's letter relative to the ejector flow increaser installed upon my recommendation in the power plant at Lock and Dam No. 1 of the Mississippi River Improvement is at hand. Mr. Herschel's position is entirely justified. In his fall increaser he has made use very effectively of the principle of the Venturi tube and has produced a device which the writer believes will do all he has claimed for it. The other device depends upon the principle of the ejector and cannot be expected to produce as great effects. It, however, will do somewhat better than Mr. Herschel's letter indicates, and, as in the case in question it was no more expensive to construct it than to omit it, the installation seems amply justified.

GARDNER S. WILLIAMS.

Ann Arbor, Mich., Nov. 21, 1914.

**High-Alloy Steels for Bridges** have been discussed at some length by J. A. L. Waddell in a paper presented before the American Society of Civil Engineers. In closing the discussion on this paper, in the "Proceedings" of the Society for October, 1914, Mr. Waddell gives the following conclusions:

1. Titanium as a scavenger of carbon steel promises good and useful results at exceedingly low cost. Although it does not increase greatly the elastic limit or the ultimate strength of the metal, it makes it much more uniform and reliable. On this account it should be used in a few cases on bridgework; and then, if it be found satisfactory, its adoption should be made obligatory by railway companies and other builders of carbon-steel bridges.

2. There appear to be great possibilities in the use of aluminum as an alloy for bridge steel. But, very few experiments in aluminum steels have yet been made; hence, the possibilities are more or less hypothetical.

3. The possibility of obtaining a good, high-alloy steel for bridges by the use of vanadium appears to be a settled fact. But the highest elastic limit and ultimate strength which can be obtained on a commercial basis by the use of that element cannot be determined without elaborate and exhaustive experiments.

## Water-Works Service Pipes

No problem in water-works operation, apparently, is of greater interest to water-works officials generally than the selection of the kind of service pipe and the method of connecting mains and services. Some points brought out in the discussion of these subjects at the November meeting of the New England Water Works Association are given herewith.

BROOKLINE PRACTICE—F. F. Forbes, superintendent of the water-works of Brookline, Mass., cited 40 years' experience with cement-lined wrought-iron pipe with no record of trouble from corrosion on straight services, but about 30 instances of corrosion at the curb cock connections.

His department has always used a lead goose-neck connection at the main to allow for settlement in the service pipe or main, which is always liable to follow disturbance of the street for subsurface construction. These goose-necks save many leaks, for several instances have been found where the goose-necks had been straightened out by settlement of the pipe yet the connection remained intact.

Service pipes are laid at a depth of 5½ ft. and no trouble is ever experienced with frozen pipes.

Some lead service pipes are used, but difficulty has been found in getting pipe to stand the high pressure used in Brookline.

In getting around subsurface obstructions, it has been found easy to bend cement-lined service pipe to as short as a 10-ft. radius without damage to the cement lining.

The pipe couplings are lined with cement while fastened to one end of a length of pipe, and the cement lining is afterwards dug out of the thread to insert the added length. The F. O. Norton brand of natural (Rosendale) cement is used, as ordinary portland cement is found to be lacking in elasticity.

The pipe fittings are galvanized-iron. Corrosion of the exterior of the pipe just inside the cellar wall is the commonest source of trouble. In such places and in locations subject to alternate wetting and drying the water department now uses galvanized-iron pipe, cement lined.

MARLBOROUGH EXPERIENCE—Geo. A. Stacey, superintendent of the water-works of Marlborough, Mass., said that two cases of lead poisoning through the use of lead pipe for well water, in the early days of the city's water-works, resulted in such a popular prejudice against lead pipe that cement-lined wrought-iron pipe was subsequently adopted for all service connections. Cement-lined iron pipe was used for eight or ten years, but much trouble was experienced by rusting out at joints. Accordingly, about 15 years ago, the water department quietly returned to the use of lead pipe, and it has been used ever since without the least suspicion of lead poisoning.

HOLYOKE EXPERIENCE—Patrick Gear, superintendent of water-works, of Holyoke, Mass., stated that ordinary iron service pipes had been in use for 40 years in Holyoke. No goose-necks are now used for connections at mains, owing to the difficulty in cleaning the service pipes. At present, galvanized-iron and lead-lined iron pipe are being used.

Conclusions—Instances were cited of long life in galvanized-iron service pipe, but these were exceptions rather than the rule.

An objection was raised to any kind of iron pipe because of the expansion and contraction, which leads to breaks at the curb cock; but this objection is largely overcome by the use of lead goose-neck connections. On the other hand, the objection to a goose-neck connection is the impossibility of cleaning the entire service from house to main. This has led to taking out all goose-necks in Holyoke, wherever new services are placed or renewals are made.

There is a need and a market for some kind of cheap expansion joint for use at curb cock connections, and a need for an effective small pipe-cleaning apparatus.

Difficulties with cement-lined service pipe are chiefly corrosion at joints and want of elasticity. The couplings must be cement-lined, or in some instances rubberoid and tar have been used successfully for lining. Sometimes lead couplings are used. Cement-lined pipe must always be sawed in two and not cut in a pipe-cutting machine, which destroys the lining in the vicinity of the cut.

Lead service pipe is the prime favorite of water-works men generally because of its freedom from corrosion, expansion and contraction troubles, and the ease with which it is bent and cut to fit any location.

Lead pipe should never be used, of course, where there is any chance of lead poisoning, but this is believed to be rare. Robert S. Weston, consulting engineer, of Boston, Mass., pointed out the extreme difficulty in determining by laboratory tests certainty as to whether water would or would not permanently affect lead pipe. Acid swamp waters are particularly dangerous.

The only real guide in many cases is experience; if lead pipe becomes coated on the interior, it is probably safe to use, but any lead pipe which retains a bright interior surface after extended use is almost sure proof that the water conducted through it has dissolved lead and is dangerous. Much popular prejudice against lead pipe is founded on sentiment rather than real reason, was the general opinion.

In many cities public-service corporations place their subsurface structures in any part of the street they see fit, and as the water main is usually near the middle of the street, the result has often been that these public-service structures have completely blanketed the water main, making straight service pipes impossible. This is a condition to be met by a better organization of city departments and by granting more authority to city officials over public-service corporation construction work.

## Reported Settlement of a Tunnel in Soft Ground

A rumor recently came to our attention that the tunnel of the Michigan Central R.R. under the Detroit River was showing evidences of settlement. As most of our readers will recall, this tunnel is a structure of concrete of rectangular cross-section and was built by floating successive steel caissons into position and filling in around them with concrete deposited under water. There would seem to be no reason why a tunnel of this type should be more liable to settlement than a circular tube tunnel, such as that under the St. Clair River, which is driven through clay very similar to that in which the Detroit tunnel lies.

We find upon inquiry that some settlement did take place during the construction of the Detroit tunnel before it was opened to traffic, and was found to be due to a small amount of leakage coming through the floor of the tunnel. This had the effect of relieving the hydrostatic pressure on the under side of the tunnel and thereby placed an enormous additional load upon the foundation soil underlying the tunnel. Measures were at once taken to stop the leakage through the tunnel floor, and when this was done the settlement stopped. There has been no ascertainable settlement since the tunnel was opened to the operation of trains; and the small amount of water which seeps into the tunnel is steadily decreasing, due probably to the gradual stoppage of the pores in the concrete by particles of silt.

## A System for Long Distance Transmission of Readings of Indicating and Recording Instruments

What is perhaps the most noteworthy development in indicating and recording devices since the invention of the several pressure, temperature, position, and other instruments themselves, is a simple system by which the instrument motion is faithfully reproduced at any desired distance up to 40 or 50 miles.

There has been a persistent demand for apparatus to show, at some point remote, temperatures, pressures,

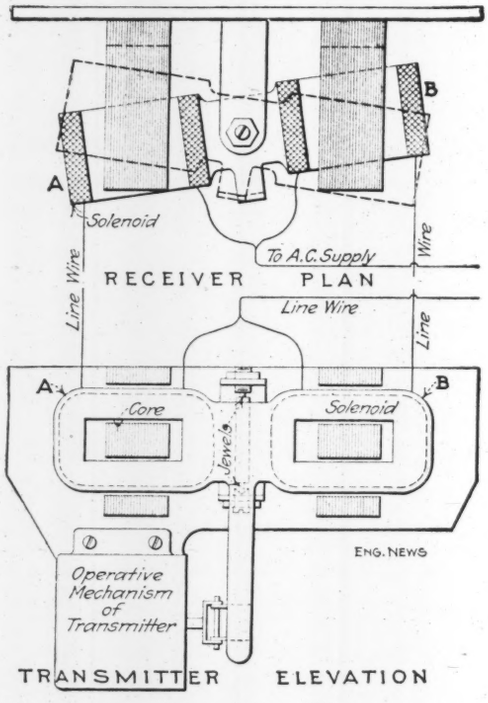



Fig. 1. Diagram of System for Transmitting Movement of Indicating and Recording Instruments

liquid levels, mechanical positions, etc., and various schemes have been put forward with partial success. Pyrometers can be used with the indicator up to 1000 ft. from the work (depending on the type) and millivoltmeters of familiar types have been used with long potential wires to measure distant voltage and current; but

no broadly applicable system for long-distance indicating and recording apparatus has been widely accepted heretofore. A serious limitation of most of the attempted apparatus is its complexity and the step-by-step nature of its operation.

The system described below enjoys the advantages of simplicity of mechanism and steady response. The scheme involved in the commercial apparatus described was worked out and patented a few years ago by J. W. Bard, of the Sangamo Electric Co., and was applied to

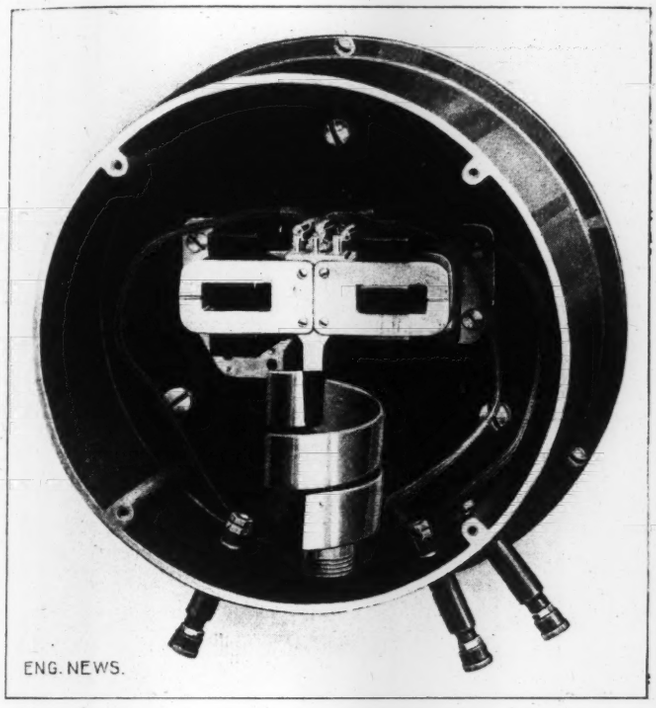



FIG. 2. COMMERCIAL FORM OF TRANSMITTING DEVICE

some Bristol recording instruments for special service. So satisfactory were such services and so frequent the opportunities for extended use, that Prof. Wm. H. Bristol was led to develop the system for use with all sorts of indicators and recorders. Although the system is only now being put on the market, yet over a dozen sets of preliminary apparatus have been in service up to four years, and are reported to be in still satisfactory operation.

The principle of the transmission system is one of induction balance, as may be seen from Fig. 1, which shows the transmitter and receiver (in elevation and sectional plan respectively). Both are similar, and each has a pair of solenoids, balanced on a shaft and hung in jewel bearings so as to swing in a horizontal plane over the ends of laminated iron cores. The transmitter solenoid is swung into some certain position by the arm and link of an operating mechanism which may be, for instance, a series of diaphragms operated by water pressure, etc. The receiver has, instead of such an attachment, a low-friction multiplying arm and link leading to the familiar indicating needle or recorder pen arm.

With the electrical connections as shown in Fig. 1, if the coil $A$ of transmitter is caused to swing on and the coil $B$ off the iron core, then the inductance of the two coils is changed. That of $A$ becomes more and that of $B$ less than before, with the result that less current flows from the alternating-current supply circuit through the $A$ coils of both transmitter and receiver, than through the $B$ side. This causes the $B$ coil of the receiver to exert a greater force than the other, so that the moving system is turned until such a position is reached as gives an unequal inductance of its coils, nearly balancing the changed condition in the transmitter coils. Then the current divides between the $A$ and $B$ circuits inversely according to their inductances until a second shift of the transmitter occurs. The alternating current produces a very slight vibration in the moving systems of both transmitter and receiver, but this is an advantage rather than otherwise, since it reduces any starting friction and makes the system practically "restless." It appears from the diagram (Fig. 1) that the moving systems of transmitter and receiver move in reverse directions as a consequence of the tendency to secure an inductive balance. Where desired, motion in the same direction can be secured by reversing the connections of the $A$ and $B$ coils.

The mechanism of the present design of transmitter, without an indicating arm, is seen in Fig. 2. Already various combinations of transmitters and receivers are being sought. The most popular form, shown in Fig. 3, comprises a transmitter with indicating needle and a distant recording receiver. By using two or more transmitters and the proper circuits and switches, readings of two or more distant instruments have been easily taken on one receiver.

The service for this system seems limited only by imagination. One of the most common demands is for the distant reporting of reservoir and tank levels, where pressure gages on pipe lines will not give true information because of friction, etc. River-stage data, water, steam, air, and gas flow and pressure, at some inaccessible point, are all items on which current data are frequently required and are satisfactorily furnished by an installation of this

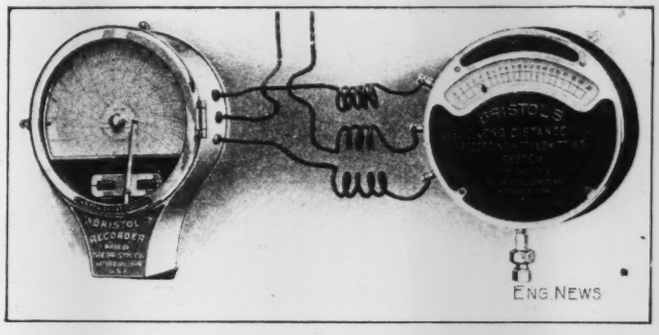



FIG. 3. INDICATING TRANSMITTER AND RECORDING RECEIVER

sort. There is a large untried field of position signal and log work, as on shipboard. Installations have been sought by citrus growers in order that the orchard office may be continually advised and have a record of the weather conditions in the coldest parts of the grove, instead of at present relying on an alarm when the danger point is reached.

**The Street Railway System of Guaynquil, Ecuador,** is equipped with electric cars having a maximum speed of about seven or eight miles an hour, with tracks zigzagging along the streets without apparent reason for deviating from a straight line. There is also a rival line of street cars drawn by undersized mules. These, a correspondent informs us, "have no difficulty in going as fast as the cars on the electric line."

# Engineers from the Contractor's Viewpoint*

By Richard W. Sherman†

That complete harmony cannot exist between engineers and contractors, by reason of each in a considerable degree representing opposing interests, is inevitable. The engineering graduate starts with an educated prejudice against contractors, whom he believes to be, in the main, determined to get the best of engineers, and therefore he is on his guard and purposes not only to take care of himself but to get the best of the contractors.

Contractors dread the "boy engineer" just from college. These young engineers are extremely technical. They expect a literal compliance with every iota of the contract obligations by the contractor.

With rare exceptions, men greatly improve in learning, wisdom and disposition as they grow older. After 20 or 30 years, a man is surprised to find how little he knew when he started his professional or business career. He has grown in riper judgment, and has developed greater caution, discretion and justice toward others. He grows considerate, amiable and kind.

Contractors are largely influenced by their opinions of engineers. The engineer who has a reputation for ability, honesty, fairness and good disposition will attract bidders for any work of which he has charge and the desire to do work under him would be an incentive to reasonably low prices. It is a feature of contracting to "size-up" the engineer with as much accuracy as possible.

In bidding for work, contractors are almost as sensitive as weathervanes. It may be possible to make a profit at a given bid under one engineer and impossible to avoid a loss under some other engineer, with all other conditions similar and the quality and the merits of the work constructed being equally good at the same cost to the owner in each case.

A majority of bids are too high. The highest bid is often twice as much as the lowest even when the lowest is sufficient. Over-anxiety to secure the contract is the commonest cause of low bidding. Low bids are often made to keep a contractor's organization together for future work on which he hopes for better prices.

Contractors who do not care for the contract often bid fairly high up, without any expectation of securing the contract but merely to avoid a reputation among contractors of being low bidders, and with the bare chance of getting the work at good prices. Excessively high bids are usually the result of lack of knowledge of the value of the work and lack of time to become familiar with it.

If an engineer's preliminary estimate is believed to be too low, it drives away bidders and tends to indifferent, high bidding. Some over-anxious contractors may be influenced thereby to bid too low. They may secure the work, in which event the engineer has an unpleasant task during construction. There is almost sure to be a disposition on the part of the contractor to save himself from loss and he is thus tempted to slight the quality of the work. Both contractor and engineer are in some degree injured by the work having been done at less than cost.

An engineer who can make reliable preliminary estimates will find his services in demand by municipalities, corporations and other owners, or if he chooses to practice as a contractor's engineer, he will find his services of great value in that field. Some prominent engineers of my acquaintance would not under any circumstances do engineering work for contractors, confining their services entirely to the owners. I know of other engineers who confine themselves wholly to engineering for contractors and who do a large business as engineering experts for contractors, in litigations.

These two fields of engineering are becoming more and more distinct and it is my opinion that an engineer is wise who makes his choice and adheres strictly either to the one line of practice or to the other.

The contracts and specifications on very large and important works usually are models of perfection. In smaller works, such as may amount to say not over $200,000, contractors are often confronted with bidding papers, contracts, specifications, plans, etc., which are a disgrace to the engineer who drew them.

There are a few engineers who are sometimes called "specification fiends." They write to many places, where work is advertised, for specifications, etc. They read them eagerly and often clip such paragraphs as catch their fancy—usually those which are harsh, severe and unreasonable from a contractor's standpoint. With these clippings to aid them, they draw up specifications, etc., which often deserve the name of "crazy-quilt" specifications.

Such papers are full of contradictions, useless paragraphs and ambiguities which are almost sure to cause contention and trouble during construction and in the final settlement, or lead to litigation. Such engineers are apt to insert severe conditions such as excessive cash deposits with the bids, unreasonably short time in which to construct the work, excessive per diem liquidated damages for overtime, excessive bonds and sometimes excessive retained percentage where monthly payments are provided. About all they can think of is to make the work undesirable and objectionable to contractors. Such engineers and their work are often avoided by the best class of bidders and the contracts are apt to go to rather undesirable contractors.

*Address before the Albany Society of Civil Engineers, Oct. 27.

†Chief Engineer, Conservation Commission, State of New York.

**Sewage Disinfection by Hypochlorite** at Providence, R. I., was continued during 1913. The results are summarized in the recently published 1913 annual report of Otis F. Clapp, City Engineer. Of a population of 241,000 about 212,000 are now served by 238.5 miles of combined sewers and there are also 16 miles of storm sewers. The domestic sewage has mixed with it the manufacturing wastes from woolen mills, bleacheries, dye houses, and jewelry factories. The total amount of sewage passing through the plant during 1913 was 8,818,000,000 gal. This volume, which included all the storm water, was treated with hypochlorite. The daily flow of sewage ranged from 51.8 to 13.7 million gallons and averaged 24.2 million gallons per day. A total of 497.5 tons of hypochlorite was used. This was at the rate of 113 lb. per million gallons. Expressed in terms of available chlorine, hypochlorite was used at the rate of 4.52 parts per million gallons of sewage. The efficiency of the disinfection process for the year, based on the reduction of B. coli, was 97.4%. The total bacteria removed (on agar, at 37½° C.) ranged from 76.9% in April, when 5.35 parts of available chlorine per million gallons of sewage were used, to 55.1% in November, with 3.74 parts of available chlorine. The combined cost of sedimentation and disinfection at Providence was $2.50 per million gallons of sewage treated. The cost of sludge disposal per million gallons of sewage treated was $2.30, and the cost of sludge disposal per ton of solids was $3.40. For earlier use of hypochlorite in the Providence plant, see "Engineering News," Dec. 25, 1913, and May 7, 1914.

## Report on Water-Power Development on the Chicago Drainage Canal

The report of a special commission on the water-power development on the Chicago main drainage canal and the disposal of the energy generated was submitted to the Board of Trustees of the Sanitary District on Nov. 12. This commission is composed as follows: Lyman E. Cooley (Consulting Engineer for the Sanitary District), John Ericson (City Engineer), Wm. Artingstall, H. H. Walker and L. K. Sherman.

The question of water-power development in connection with the drainage canal was considered as early as 1897, but was delayed by litigation and other causes. The District assumed that its general fund was not available for this purpose, but in 1903 a law was passed authorizing a special tax for three years for such development. The tax produced $3,050,624, but this was exhausted by the end of 1906, and the work was continued by loans (at 4% interest) from the general fund. The plant at Lockport was opened in 1907. The law of 1903 provided specifically for utilizing the water power for the generation of electric current, the use of this current for operating the pumping stations and bridges of the District, and its transmission to municipal corporations within the Sanitary District, the evident intent being that the distribution and retailing of current should be left to these corporations.

The total expenses incident to development, transmission and distribution, up to the end of 1913 amounted to $6,714,200. Excluding the distribution undertaken, though not originally contemplated, the expenditures were $5,063,648. In Chicago alone the distribution has amounted to $1,619,553. It is considered probable that the distribution will be eliminated eventually, in accordance with the original purpose. The present return is barely sufficient to meet current expenses, and unless the rates are increased the District must continue to invest new capital.

The commission considers that the following conditions are necessary for making the water-power enterprise a valuable property: (1) Uniform flow in the drainage canal, with a volume adequate to a sanitary condition and not less than 20,000 min.-ft. for each 100,000 people; (2) increased return on the investment by more favorable rates and increased output (by passing a greater volume of water); (3) modernizing the power plant and thus increasing its efficiency. In addition, various changes in administration and accounting systems are recommended, with the abandonment of all distribution beyond the transmission terminals.

In a separate report, Mr. Cooley deals with the power plant, and states that the present equipment gives a plant of moderate or low efficiency which is costly to maintain and operate. It consists of seven horizontal-shaft units of 6000 hp., with six turbines to each generator. Space is provided for an additional unit. The eight units with 34-ft. head and 80% efficiency would represent 42,650 hp. He advocates new units consisting each of a vertical turbine with an overhead generator, each unit being equivalent to two present units (with their 12 turbines). Such a plant should have an over-all efficiency exceeding 80% under working conditions; this is more than 10% above that called for by the present plant, and still higher than the efficiency realized in practice. His conclusion is that such results call for any betterments than can be made in the plant and in its maintenance and operation, and perhaps would justify a complete modernization of the plant

## An Exhibit of Modern Street-Cleaning Apparatus

The first exhibition of devices and machines for municipal street cleaning to be held in this country was very successfully carried out during the week of Nov. 23, under the auspices of the New York City Street Cleaning Department, of which John T. Fetherston is Chief. The exhibits were intended not only for the education of the employees of the department and the general public, but to provide an opportunity for practical tests or demonstrations of unfamiliar apparatus.

The exhibits included brooms, brushes, sweeping machines, flushers and squeegees, snow plows, carts and wagons, and various receptacles for garbage, ashes and rubbish, including special carts and wagons designed to be both dust- and odor-proof. Besides these there was an interesting collection of original posters designed by public-school children as a part of a plan to interest the tenement-house population of the city in keeping the streets and alleys clean and tidy.

The exhibits of street-cleaning apparatus may be divided into four general classes, as follows: (1) Sprinklers, flushers and squeegees; (2) sweepers and sweeping machines; (3) snow plows and scrapers; (4) wagons and receptacles for garbage and refuse. Noticeably absent was an exhibit of vacuum cleaners, which are the most recent development in street-cleaning apparatus.

The accompanying views show some of the more interesting exhibits, excepting those in class (4) above, which will be illustrated in a later issue. The largest exhibitor was Charles Hvass & Co., of New York City, two of whose exhibits, an automobile sprinkler (Fig. 3) and a combined sweeper, sprinkler and scrubber (Fig. 5), attracted attention. The new principle in the sweeper and scrubber is the pushing of the broom instead of pulling it, as is done in other machines. The next largest exhibitor was probably the Studebaker Bros. Manufacturing Co., whose chief exhibits were a constant-pressure flusher (Fig. 2), the pressure being furnished by a centrifugal pump driven by a 30-hp. gasoline engine mounted on the rear of the truck, and a combination sweeper and sprinkler (Fig. 6), which has a spraying device in front of the broom, designed to eliminate dust.

Various types of pick-up sweepers were exhibited, two of which are illustrated. The Hvass exhibit included a small pick-up sweeper. Another type is the "Charlton" sweeper, made by William Dubocq, Brooklyn, N. Y. (Fig. 9), which has had considereable service in New York. The pick-up mechanism in this sweeper is on one side of the rear wheels and the refuse is discharged into cans, which are easily removed from the body of the wagon. The newest type of pick-up sweeper was that exhibited by the Merritt Street Sweeping Machine Co., New York City (Fig. 8). This is a four-wheel, steel-frame vehicle with a rotary broom on either side, set at angles to sweep the dirt into a row under the machine, where a rear broom sweeps the row over a flexible steel shoe to a conveyor, which carries the sweepings up and through a

# Exhibit of Street Cleaning Apparatus

FIG. 1. GENERAL VIEW OF EXHIBIT IN THE ARMORY OF THE FIRST REGIMENT OF FIELD ARTILLERY, NEW YORK CITY, WEEK OF NOV. 23. HELD UNDER THE AUSPICES OF THE NEW YORK STREET CLEANING DEPARTMENT.

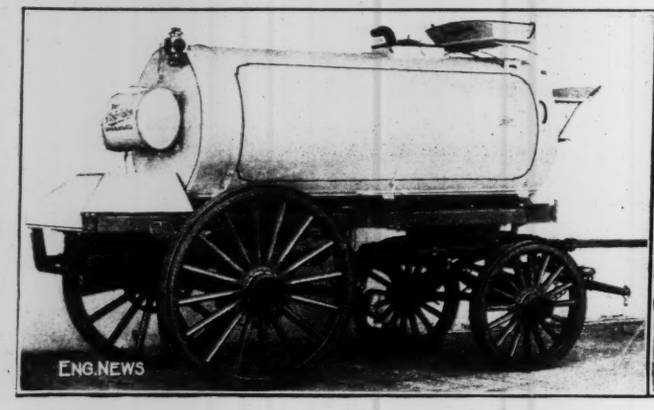



FIG. 2. CONSTANT PRESSURE STREET FLUSHER MADE BY THE STUDEBAKER CORPORATION OF AMERICA

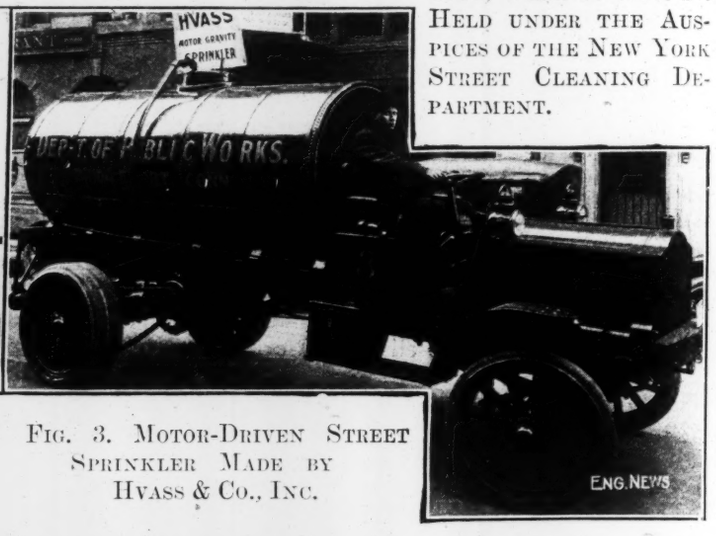



FIG. 3. MOTOR-DRIVEN STREET SPRINKLER MADE BY HVASS & CO., INC.

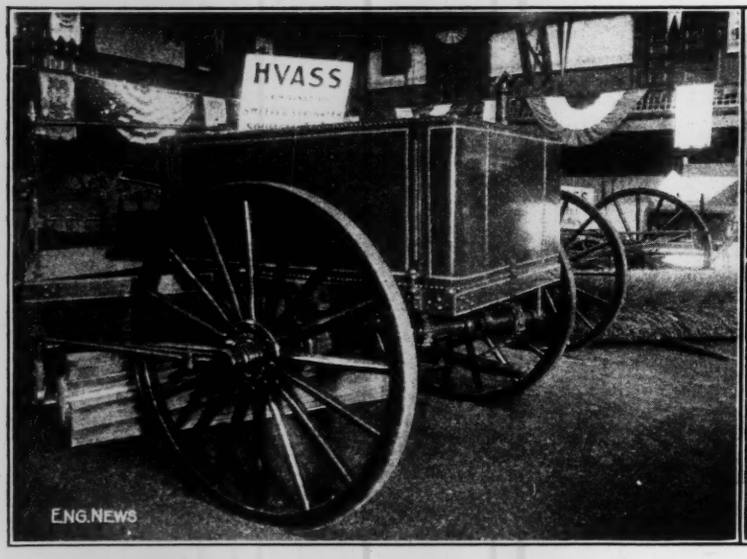



FIG. 4. COMBINATION SWEEPER, SPRINKLER AND SQUEEGEE, MADE BY HVASS & CO., INC.

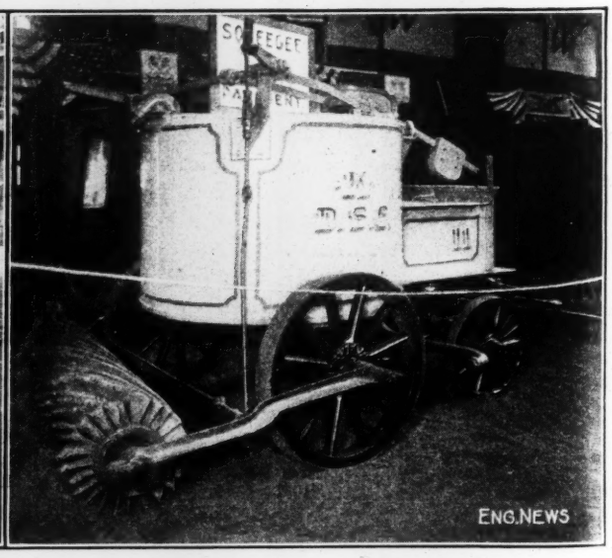



FIG. 5. STREET WASHING SQUEEGEE MADE BY KINDLING MACHINERY, CO., MILWAUKEE, WIS.

# Exhibit of Street Cleaning Apparatus

## Two Recent Developments in Standard Street Sweepers

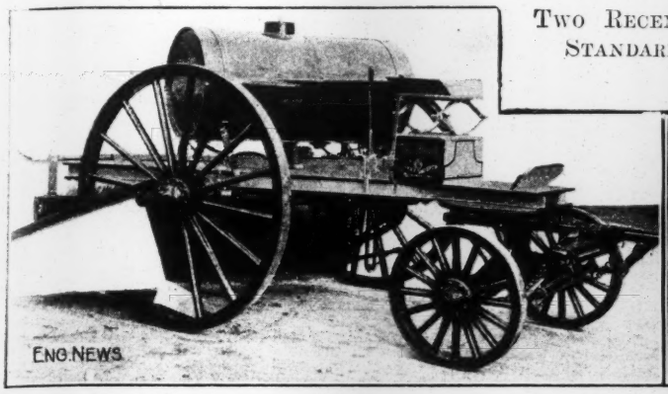



Fig. 6. Combination Street Sweeper and Sprinkler to Eliminate Dust. Made by the Studebaker Corporation of America

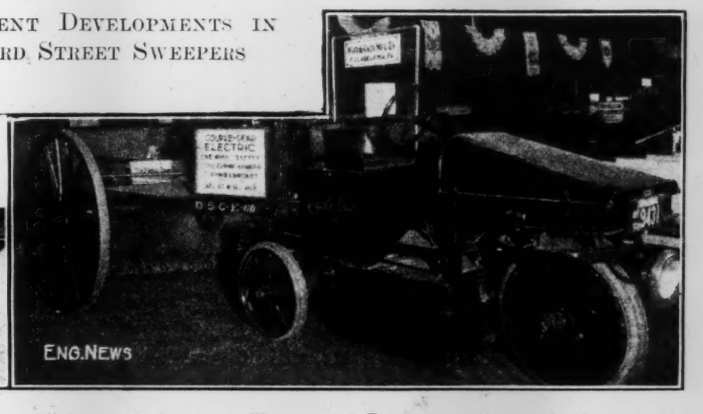



Fig. 7. Electric-Tractor Driven Street Sweeper of the Ordinary Type. Made by the Wirt & Knox Co.

## Latest Types of Pick-Up Street Sweepers

Fig. 8. Pick-Up Sweeper. Made by the Merritt Street Sweeping Machine Co. Invented by a New York City Policeman

Fig. 9. "Charlton" Pick-Up Sweeper. Made by William Dubocq. View Showing Side with Pick-Up Mechanism; Other Side Has an Ordinary Wagon Wheel
This Sweeper Has Been Used for Some Time in New York City

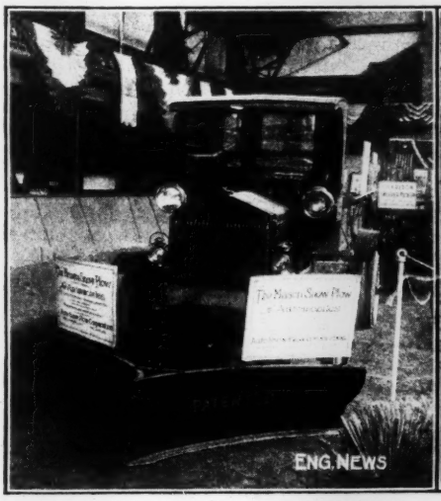



Fig. 10. "Mason" Snow Plow. Made by the Auto Snow Plow Corporation

Fig. 11. Snow Plow and "Ice Remover" Exhibit of the Baker-Barron Co. In the Background Is the Sweeper Exhibit of the Universal Road Machinery Co., Kingston, N. Y.

double chute into cans, placed on a revolving platform for convenience in spotting under the chutes.

Snow-plow exhibits ranged all the way from the old-style one-horse blade to the new "Mason" automobile-truck plow, made by the Auto Snow Plow Corporation, New York City (Fig. 10). Snow plows of the road-scraper type were exhibited by the Good Roads Machinery Co., Inc., New York City, and the Baker-Barron Co., Inc., New York City (Fig. 11). The newest device in this class was the "ice remover," made by the latter company (Fig. 11). This is a plow and toothed scraper combined on sled runners, and is designed to remove the thin film of ice and snow which makes smooth pavements so slippery in winter.

Various types of motor vehicles for municipal use were exhibited, including a small three-wheel electric tractor for hauling an ordinary rotary-broom sweeper (Fig. 7), made by the Wirt & Knox Manufacturing Co., Philadelphia, and a gasoline-engine electric-power generating unit for melting frozen water-service pipes, etc., made by the General Vehicle Co., New York City. Other types of motor trucks were exhibited by the Commercial Truck Co. of America, Philadelphia, the Ward Motor Vehicle Co., New York, the Lansden Co., Brooklyn, and the Four-Wheel Drive Auto Co., New York City. The exhibits were particularly interesting in showing the wide adaptability of motor trucks and tractors to municipal uses.

Among the more unusual exhibits were models of a snow-melting device by means of a portable boiler and steam kettles, invented and shown by Howard G. Lapsley, Plainfield, N. J., and a model of a machine designed to sprinkle, flush, rake, loosen, sweep, load, dump and level street refuse; it is also designed to carry and distribute road-repair materials and oils, and serve as a road scraper and scarifier. This device was exhibited by the Universal Road Repairing & Street Cleaning Co., Philadelphia. Photographs and drawings of a vacuum-cleaning machine were exhibited by the Way-Cleanse Co., Sandusky, Ohio.

## NEWS NOTES

**A Grain Elevator Burned in Galveston, Tex.,** belonging to the Southern Pacific Co., on Nov. 17. It is reported that the elevator contained about 800,000 bu. of wheat and that the loss is estimated at $2,000,000.

**An Earthquake in Western Greece** and the Ionian Islands killed 23 persons, according to press dispatches. On the island of Santa Maura a mountain crumbled for nearly two miles and the water of the Ionian Sea covered 125 acres of the valley.

**Falsework of a New Concrete Building Collapsed** at Logansport, Ind., on Nov. 10, killing one man and injuring six others. It was a three-story building. A concrete mixer had just been hoisted to the third floor for completing the coping and it was this load that caused the accident.

**A Tight-Joint Sewer System** is desired for the village of Averyville, Ill., as a means of protection of the water-supply system of the adjacent city of Peoria. To insure this protection the Peoria Water Works Co. has made plans for the Averyville sewerage system and proposes to furnish and lay the pipe. The plans and specifications have been prepared by Ray Crozier, Resident Engineer of the water company.

**The Cumbre Tunnel** of the Mexico Northwestern Ry., in the Sierra Madres, which was destroyed by a band of revolutionists more than a year ago, will soon be reopened, according to press dispaches. A "shoofly" track, 25 mi. long, will be built around the tunnel. As soon as the tunnel is reopened, through traffic between Juarez and Chihuahua via Pearson and Madera will be resumed.

**Miami & Erie Canal Partly Closed**—The Miami & Erie Canal is closed to navigation at the present time from Defiance to Middletown, Ohio. This is the result of failure to provide enough money to maintain the canal. Many of the locks are out of condition and nothing has been done in the last two years to restore them. It is thought probable that the next legislature of Ohio will order all parts of the canal thus out of commission and those not used for hydraulic purposes to be drained. The canal is in charge of the State Department of Public Works, John I. Miller, Superintendent.

**Sanitary Industrial Surveys by New York City Health Department**—The weekly bulletin of the Department of Health, City of New York, for Nov. 14, makes the following announcement:

The Department of Health is prepared to undertake a sanitary survey of any industry, trade or group of manufacturing or mercantile establishments in this city, with a view to appraising existing conditions and in order to show to employers and workers alike what can be accomplished through a system of voluntary hygienic and sanitary control. Through its Bureau of Public Health Education, the department will be glad to assist in formulating sanitary industrial standards and measures for the prevention of occupational diseases. In addition to this, the bureau stands ready to prepare and furnish health leaflets specially designed for workers in any industry, and to supply popular lectures on health and sanitation to such workers, in coöperation with either employers or trade unions.

**A New Record in Precise Leveling** has been established by John H. Peters, Assistant, U. S. Coast and Geodetic Survey, whose remarkable record of 120 miles in a calendar month was noted in our issue of Oct. 29, 1914, p. 886. This record was broken in October, in the State of Washington, when 148.3 miles of precise level line was established, equivalent to a total number of miles of single line of 327.7. The party worked 24½ days, and the average amount of time devoted to leveling was 6.6 hr. per day. Benchmarks were set for the most part and records checked by the observing party. All the leveling comes within the requirements that the two runnings of a section agree within 4 mm. $\sqrt{\text{distance in kilometers}}$.

**Construction of New Buildings at Wellesley College,** Wellesley, Mass., to permanently replace those destroyed by fire on Mar. 17, is about to begin. A new college hall will be commenced first. It will be U-shaped, with entrances on the north and south sides. On either side will be a smaller dormitory joined to the main building by stone cloisters. Underneath the cloisters and connecting all buildings will be two tunnels—one for the use of tradesmen, the other to house the heating, water, sewer and lighting piping and conduit. All stairways will be inclosed. A temporary frame one-story building was erected in remarkably short time (March. 27-Apr. 7), to take the place of the burned college hall, and was described in our issue of May 7, 1914, p. 1018.

**Popular Good Roads Enthusiasm** in the mud road districts of the Central West apparently knows no bounds. The following item is from the De Kalb, Ill., "Chronicle" of Nov. 13:

Malta had a most enthusiastic celebration yesterday afternoon about 5 o'clock. Anyone in the vicinity might have thought from the number of whistles that were blowing and the fuss that was being made that the entire town was on fire, but such was not the case. Instead, the cause of the hilarity was the fact that the new cement road leading west from Malta for a distance of a mile and a quarter or so had just been finished, and the work was done at a few minutes before the blowing of the whistles commenced.

Easterners recall such celebrations at the time of Dewey's capture of Manila in 1898, and perhaps on one or two occasions of nearly equal historical importance, but never on the occasion of the opening of a mile and a half of hard road.

**Survey for the El Paso Union Stockyards** at El Paso, Tex., was begun on Nov. 13. The new yards will have capacity for 25,000 head of cattle, 3000 hogs and 10,000 sheep. The entire plant will cover 45 acres when complete, while the yards proper will cover 30 acres. The yards will have an unloading capacity of 75 cars at one time. In the pens, 1,500,000 ft. b.m. of yellow pine will be used. A flushing system connected with the city water supply will permit daily cleaning of the pens. Fire-plugs will be placed in all parts of the yards. Concrete paving will be used wherever possible. The exchange building, as now planned, will be 120x40 ft. and of Spanish Mission design, with tile roof and stucco finish. There will also be a hay barn 200x50 ft., with capacity for 75 carloads of hay. It is claimed that the El Paso Union Stockyards Co. will commence construction in the immediate future.

**The Employees of Contractors** on the New York Rapid Transit Ry. extensions during the month of November numbered 19,223 men. About 16,000 of these are at work on subway contracts and the balance are employed by contractors working on extensions, sidetracking, etc., of the

vated railway system, which work is done directly by e companies. On the 64 sections now under contract, the tal contract price is $146,253,000. Contracts in force for ird-tracking involve $8,000,000 to $10,000,000 additional on e Manhattan and Bronx lines and $6,000,000 on the Brooklyn es, making a total of about $162,000,000 of contracts now force. Bids were opened on Dec. 1 for the construction a station on the Fourth Ave. subway in Brooklyn, and are be opened on Dec. 11 for the Broadway subway between st and 59th St. Bids for two or three additional sections ill probably be advertised before the close of the year.

**The Massachusetts Basis for Utility Rates,** or the Public Service Commission's idea of fair value, is thus expressed in the Middlesex & Boston Street Railway Co. six-cent fare case:

It is argued by some of the counsel that the present value of the property used by the petitioner is the only amount upon which it can claim to earn a return. * * * It is sufficient here to observe that few words having a fundamental importance in dealing with questions of law and finance have been found more difficult of accurate and generally accepted definition. * * *

In this fairly consistent adherence to sound principle our Massachusetts public utility code is in striking contrast with the loose and haphazard legislation as to capitalization in many other states, which has requently resulted in compelling their regulating commissions to resort to reproduction cost as perhaps the least unsafe basis for determining a fair rate. Accordingly, we rule that under Massachusetts law capital honestly and prudently invested must, under normal conditions be taken as the controlling factor in fixing the basis for computing fair and reasonable rates; that if there is mismanagement causing loss, such loss must be charged against the stockholders legally responsible for the mismanagement; that reproduction cost either with or without depreciation, while it may be considered, is not, under our law, to be taken as the determining basis for reckoning rates.

In the case at hand the company was ordered to raise the fares to 6c. for single rides, nine tickets for 50c., and ten school tickets for 30c.

**An Effective Ordinance for Pavement Preservation** went into effect in the Borough of Washington, Penn., Nov. 16. Section 1 of the new ordinance provides that no pavement opening shall be made without a special permit, which (Section 2) must specify where the opening is to be made, the number of square yards of pavement to be disturbed, the time such excavations may remain open, and the total charges for the permit granted. Section 3 provides for a charge of $2 per sq.yd. of paved street opened, payable in advance or within 30 days, or secured by a bond. Section 4 gives authority to the holder of the permit to make the excavation. Section 5 provides that the party shall properly refill excavations in unpaved streets. Section 6 makes it the duty of the Borough Engineer to take over the backfilling in all paved streets. The base of the pavement is cut away 10 in. on all sides of the trench, and where the trench width is less than 30 in., a 5-in. concrete base is laid; over 30 in., a 6-in. base. Violation of the ordinance entails a fine of $25. Section 9 makes it unlawful, except by special vote of the town council, for any person, partnership or corporation to dig or make a trench, ditch or excavation in the streets or alleys of the borough between Dec. 1 and Apr. 1, unless for the purpose of making necessary repairs to leaking gas or water pipes, or to remove an obstruction in sewers, under a penalty of from $5 to $100.

**The National Grange on Road Improvement**—The discussion of highway improvement by the National Grange, at the recent annual convention in Wilmington, Del., is of much interest because of the political influence, both local and national, wielded by this nation-wide association of farmers. The meeting unanimously adopted a report of a special committee of seven, of which T. C. Atkeson, of West Virginia, was chairman, appointed last year to amplify the Grange road policy. The committee stated that the Grange had been the pioneer in the good roads movement; that the sentiment for good roads was practically universal, but that there was great danger of this sentiment being diverted toward the construction of scenic highways and boulevards, for the benefit of tourists and pleasure-seekers, rather than for the business interests of the general public. The convention, in adopting the committee report, expressed its opposition to the many bonding schemes advanced by those seeking touring roads, and urged the legislative committees of the Grange, both national and state, to use every honorable endeavor to obtain first business roads that will serve the best interests of both producer and consumer. In part, the resolution read:

Roads are local affairs and their control should remain with the people in whose midst they are located. The national and state governments may provide general standards for construction and maintenance of roads and may protect themselves by inspection. We call the attention of all our people to the grave danger in top-heavy, bureaucratic control of road administration, and to the fact that much of the support for the good roads comes from those who are more anxious to build roads for bonds than to sell bonds for roads.

## PERSONALS

Mr. R. W. Reynolds has resigned as General Manager of the Springfield (Mass.) Street Ry. Co. to become General Manager of the Mesaba Street Ry. Co., Virginia, Minn.

Mr. Stephen E. Wilson, who designed the new municipal garbage-reduction plant at Dayton, Ohio, has been employed to supervise its construction and manage its operation.

Mr. David McNichol, Vice-President of the Canadian Pacific Ry., Montreal, Que., has resigned. He is succeeded by Mr. George Bury, Vice-President, who heretofore has made his headquarters in Winnipeg, Man.

Mr. E. W. McKenna has resigned as Vice-President of the Chicago, Milwaukee & St. Paul Ry. after over half a century of railway service, begun in 1862 as a messenger and telegraph operator with the Pennsylvania R.R.

Mr. Milo M. Backus, recently Supervisor of the Illinois Central R.R., at Princeton, Ky., has been promoted to be Roadmaster of the Springfield division, with headquarters at Clinton, Ill., succeeding Mr. Lewis H Bond, transferred.

Mr. H. S. Morse, M. Am. Soc. C. E., formerly Engineer in charge of sewerage investigations at Cincinnati, Ohio, is now Engineer of the Ohio Institute for Public Efficiency, Hartman Bldg., Columbus, Ohio. He is temporarily engaged on some special work for the Cincinnati Bureau of Municipal Research.

Mr. H. M. Flanders, Engineer of Maintenance-of-Way of the Springfield (Mass.) Street Ry. Co., has been promoted to be General Manager, succeeding Mr. R. W. Reynolds, resigned as noted elsewhere. Mr. Flanders was educated at the Massachusetts Institute of Technology and was formerly with the Newton (Mass.) Street Ry. Co.

Mr. Otto Lemberger, formerly a consulting engineer and surveyor of Chihuahua, Mexico, who returned to his native country of Austria in 1913 to engage in stereophotographic survey work under Capt. von Orel, the inventor of the stereoautograph, has been made a lieutenant in the Austrian Army and is now on the fighting line.

Mr. Richard Sachse has been appointed Chief Engineer of the California Railroad Commission, with headquarters in San Francisco. Mr. Sachse entered the service of the Commission in 1911 as Assistant Engineer. He was promoted to the position of Principal Assistant Engineer in 1913, and has been Acting Chief Engineer since December, 1913. Prior to his service with the Commission he had been with the Western Pacific Ry., the Southern Pacific Co. and the United States Reclamation Service.

## OBITUARY

John C. Muir, General Superintendent of the Chicago, Terre Haute & Southeastern R.R., died at his home in Terre Haute, Ind., Nov. 4, at the age of 50 years. His railway experience began in 1879 as a messenger boy with the Atchison, Topeka & Santa Fé Ry.

Charles Willard Kettell, a retired mechanical engineer, died Nov. 18 at his home in Lexington, Mass. He was born in Charlestown in 1848, and graduated from Harvard University in 1870 and from the Lawrence Scientific School in 1873. He practiced his profession of mechanical engineering first in Fitchburg, Mass., and later in Boston. He is survived by a widow and a daughter.

Forrest E. Barker, Chairman of the Massachusetts Gas and Electric Light Commission, died Nov. 20, in Washington, D. C., where he had gone to attend the annual convention of the National Association of Railway Commissioners. He was born in Exeter, N. H., in 1853, and graduated from Wesleyan University, Middletown, Conn., in 1874. He studied law and for a time practiced in Worcester, Mass. Mr. Barker was appointed a member of the Massachusetts Gas and Electric Light Commission in 1885, and ever since then had been one of its ablest members.

Frank H. Rogers, Superintendent of Construction, United States Treasury Department, died recently in Wheeling, W. Va., from the effects of an accident. He was supervising the construction of a Federal building in Wheeling and was injured by the falling of a block of stone. He was born in West Newbury, Mass., in 1874, and graduated from the Massachusetts Institute of Technology in 1896. He was employed in the city engineering department of Boston, Mass., until 1905, when he was appointed Superintendent of Construction on United States Government work. He is survived by a widow and a two-year-old daughter.

Douglas S. Martin, former Editor of the "General Electric Review," and later a member of the editorial staff of the "Electrical World," died recently at the Boulogne Hospital, France, from shrapnel wounds received in the battle of Messines. He was enlisted in the British Army. Mr. Martin was a grand nephew of Dr. Samuel Smiles, author of the "Lives of the Engineers," and a brother of T. C. Martin, Past-President of the American Institute of Electrical Engineers, Secretary of the National Electric Light Association. He was born in England and received his education at the Central Technical College in London. He was 27 years old.

## ENGINEERING SOCIETIES

### COMING MEETINGS

AMERICAN INSTITUTE OF ARCHITECTS.
Dec. 2-4. Convention at Washington, D. C. Secy., D. Knickerbacker Boyd, The Octagon, Washington, D. C.

ASSOCIATION OF AMERICAN PORTLAND CEMENT MANUFACTURERS.
Dec. 7-10. Annual meeting in New York City. Secy., Percy H. Wilson, Bellevue Court Bldg., Philadelphia, Penn.

AMERICAN MINING CONGRESS.
Dec. 7-11. Annual meeting at Phœnix, Ariz. Secy., J. F. Callbreath, Denver, Colo.

NATIONAL SOCIETY FOR THE PROMOTION OF INDUSTRIAL EDUCATION.
Dec. 9-12. Convention at Richmond, Va. Secy., C. A Prosser, 140 W. 42d St., New York City.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.
Dec. 10-11. Annual meeting at New York City. Secy., D. H. Cox, 29 W. 39th St., New York City.

AMERICAN ROAD BUILDERS' ASSOCIATION.
Dec. 14-18. Convention at Chicago, Ill. Secy., E. L. Powers, 150 Nassau St., New York City.

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS.
Dec. 28-30. Annual meeting at Chicago, Ill. Secy., F. M. White, Madison, Wis.

SOCIETY OF CONSTRUCTORS OF FEDERAL BUILDINGS.
Jan. 4-6. Convention at Washington, D. C. Secy., T. R. Maul, 4213 Westminster Ave., Philadelphia, Penn.

ASSOCIATION OF GOVERNMENT CONTRACTORS.
Jan. 4-7. Annual meeting at Washington, D. C. Secy., Algernon Blair, Montgomery, Ala.

AMERICAN SOCIETY OF ENGINEERING CONTRACTORS.
Jan. 15. Annual meeting at New York City. Secy., J. R. Wemlinger, 11 Broadway, New York City.

AMERICAN WOOD PRESERVERS' ASSOCIATION.
Jan. 19-21. Convention at Chicago, Ill. Secy., F. J. Angier, Mt. Royal Station, B. & O. R.R., Baltimore, Md.

AMERICAN SOCIETY OF HEATING & VENTILATING ENGINEERS.
Jan. 20-22. Annual meeting at New York City. Secy., J. J. Blackmore, 29 W. 39th St., New York City.

AMERICAN CONCRETE INSTITUTE.
Feb. 9-12. Convention at Chicago, Ill. Secy., E. E. Krauss, Harrison Bldg., Philadelphia, Penn.

**Compressed Gas Manufacturers' Association**—The annual meeting will be held at the headquarters of the Association, 25 Madison Ave., New York City, at 2:30 p.m., Jan. 18. The Secretary is John J. O'Rorke.

**Springfield (Mo.) Engineers' Club**—An Engineers' Club at Springfield, Mo., has recently been organized. The membership of 85 is composed largely of engineers of the Frisco Lines, whose headquarters are i nthat city.

**National Conference on Concrete Road Building**—Secretary J. P. Beck, 208 South La Salle St., Chicago, Ill., states that the second national conference on concrete road building will probably be held some time in February, 1916.

**American Society of Mechanical Engineers**—At the annual meeting, to be held in New York, Dec. 1-4, there will be an all-day session on the "Engineer in Public Service," under the auspices of the Public Relations Committee of the Society.

**American Wood Preservers' Association**—The 11th annual convention will be held in Chicago, Jan. 19-21, with headquarters at the Congress Hotel. The program will be issued shortly. The Secretary is F. J. Angier, Baltimore & Ohio R.R. Co., Baltimore, Md.

**Society of Constructors of Federal Buildings**—The fifth annual convention of the Society will be held in the rooms of the Washington Architectural Club, 1517 "H" St., N. W., Washington, D. C., Jan. 4-6; program will shortly be issued. The Secretary is T. R. Maul, 4213 Westminster Ave., Philadelphia, Penn.

**New England Water Works Association**—At the Dec. 9 meeting, in Boston, Mass., in addition to the presentation of two water-works papers, the topical discussion on the general subject of service pipes, begun at the November meeting and reported elsewhere in this issue, will be continued. The Secretary is Willard Kent, Narrangansett Pier, R. I.

**Duluth Members of American Society of Civil Engineers**—A branch of the American Society has just been organized in Duluth, Minn., for the benefit of the 17 members of the national body, living in the city and vicinity. The president is F. E. House, President of the Duluth & Iron Range Ry., the secretary is Walter G. Zimmerman, Manager of the American Bridge Co. Meetings will be held from time to time.

**Association of Government Contractors**—The third annual meeting of the Association will be held in Washington, D. C., Jan. 4-7, with headquarters at the Hotel Raleigh. This meeting will include a conference on the first day with manufacturers, dealers and subcontractors; on the second day a joint meeting will be held with the Society of Constructors of Federal Buildings.

**Engineers' Society of Philadelphia**—Plans are being drawn by Philadelphia engineers to unite their several organizations into one body, to be called the Engineers' Society of Philadelphia, with headquarters at the present address of the Engineers' Club, 1317 Spruce St. A committee has drafted by-laws and regulations, which will be presented to each association for acceptance. It is said that there will be about ten such organizations in the new society.

**American Society of Agricultural Engineers**—The annual meeting will be held at Chicago, on Dec. 28-30. One session will be devoted to a series of papers on "The Place and Field of the Agricultural Engineer," by the deans of half a dozen engineering colleges. Another session will be devoted to papers and discussions on education in agricultural engineering. At the third business session there will be papers on soil treatment, the fuel economy of small gas engines, the draft of farm wagons, and the design of farmhouses. The Secretary is F. M. White, Madison, Wis.

**Aëronautical Society of America**—What is termed the first joint conference on aviation will be held by the Aëronautical Society of America, in conjunction with other national engineering organizations, Feb. 5-6, 1915, when inventions tending to increase the stability and safety of flight in heavier-than-air machines will be considered. Those wishing to submit their inventions are invited to communicate with the Technical Board of the Society, at 29 West 39th St., New York City. Other societies represented will be the American Society of Mechanical Engineers, the American Mathematical Society and the American Physical Society.

**The American Society of Engineering Contractors**—The annual meeting will be held in New York on Jan. 15. At a recent meeting of the Board of Directors a report of the record, efficiency and accomplishment of the various committees was submitted by a special committee appointed to revise the present work of the Technical Standards committees. It is very probable that several committees, whose fields overlap those of the larger engineering societies, will be discontinued. It is the desire of this Society to concentrate its efforts on the solution of the problems facing engineering contractors. The Secretary is J. R. Wemlinger, 11 Broadway, New York City.

**American Association for the Adoption of the Metric System**—This organization was recently launched under the auspices of the Oregon Society of Engineers. Its object is to educate the American public in the advantages of the metric system of weights and measures, to extend its use in the United States, and to discover a rational plan whereby it may be generally adopted without inconvenience or pecuniary loss to existing industries. There are no restrictions as to membership. The fee is $1. Temporary officers have been selected who will serve until the first meeting of the association, which will be held in San Francisco in connection with the International Engineering Congress, Sept. 20-25, 1915, when permanent officers will be chosen. The temporary secretary is J. A. Stevens, Portland, Ore.

**Boston Society of Civil Engineers**—The Society has recently detailed a member who has a facile pen to put accounts of its activities into form suitable for the newspapers. The Society, which is the oldest in the country, and now has a membership of nearly 900, is beginning to feel that it should take an active interest in local affairs and especially in legislation affecting engineering matters. It is also beginning to realize that its actions will have greater weight if the people and the legislators are first made to appreciate that its members are responsible for nearly every work of engineering investigation and construction in New England. That live matter is always welcomed by the daily press was shown by the space which the Boston papers gave to an address delivered before the Society on Nov. 18 by Henry M. Waite, City Manager of Dayton, Ohio, and formerly City Engineer of Cincinnati. The address was on the city-manager plan of municipal government.